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Driving and parking patterns of European car drivers – a mobility survey.

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Executive Summary

The development of innovative vehicles such as electric driven cars is an important potential option for improving the sustainability of the transport sector. A significant penetration of electric vehicles in the market is possible only if their use is compatible with mobility patterns of individuals. For instance, the driven distance should be compatible with the batteries range or parking patterns should enable re-charging. The JRC-IET together with TRT and IPSOS analyzed car mobility patterns derived from direct surveys in six European Union Member States (France, Germany, Italy, Poland, Spain and United Kingdom). The report aims at providing some insights on how electric vehicles could fit mobility habits of European car drivers. The analysis is based on the data collected within six European countries by means of a sample survey. A web-based car trips diary was filled in by on average 600 individuals in each country. The individuals logged for 7 consecutive days their driving and parking patterns in 5 minute intervals. For each trip several details such as departure and arrival time, distance and parking place were registered. Socioeconomic characteristics of individuals were also collected. The same questionnaire format was used in all countries allowing for comparability of responses. Representativeness of the derived data was ensured by weighting and aligning the received sample to the socio-demographic reference universe of each member state. Survey results are statistically analyzed to describe mobility patterns. In particular, the information on average number of car trips per day, daily travel distance, daily travel time, trip distance, distribution of parking and driving, distribution of parking places, trip purposes, duration of parking and many other parameters per Member State are analyzed and presented in the report. Moreover, the analysis of the survey data shows which share of driving patterns are compatible with the use of electric cars with their current technical features (batteries range, re-charge time) under alternative assumptions about the availability of re-charge facilities. Also differences and similarities between countries and user groups are discussed.

Overall, the results of the survey provide representative driving profiles for estimating the charging profiles of electric vehicles and many other indications on how people use their car. The outcomes of the survey provide relevant methodological hints to develop similar surveys in other contexts or to repeat the survey in other countries.

1 Introduction

Personal mobility has evolved as a distinctive trait of modernity in Europe. Allowing citizens to move faster, farther, more safely and comfortably has been a key policy goal in the last decades and still is. Within this process, car has played a major role. The progress of individual mobility has been strongly interlinked with the history of mass motorization. This history can be considered a successful one. Its success, however, has increased personal mobility tot the extent that its undesired effects became more and more significant. Congestion, pollution, accidents, traffic fatalities, greenhouse gas emissions can be quoted as the major ones. The European Union has started a number of policy initiatives to reduce the negative effects of cars while at the same time fostering the competitiveness of the European transport sector.

In March 2011 the new Transport White Paper Roadmap to a Single European Transport Area – Towards a Competitive and Resource-efficient Transport System (European Commission 2011a) was published. As a very important element, this new White Paper builds on the European objective of reducing greenhouse gas emissions (GHG) by 80 to 95% until 2050 compared to 1990 (European Commission 2011b). Transport in the White Paper is expected to contribute to these GHG reductions by decreasing its GHG emissions by at least 60% compared to 1990, while maintaining a competitive and resource-efficient transport system.

One key instrument within this strategy is technology. In the automotive sector, research aims at developing more parsimonious conventional vehicles or even (on site) zero emissions cars. Within this effort, electric-drive vehicles (EDVs) are on the forefront of non-conventional powertrain technology developments. Nevertheless, in some respects they still lag behind conventional vehicles, namely for costs, driving range and refueling speed, and further progress is needed. Thus, in the short and medium term the penetration of EDVs in the market would depend not only on their cost, but also on how they can fit driver needs despite the fact that their features are not the same as those of conventional cars. At the same time, once an EDVs share in the fleet increases a certain portion of electric power will be requested daily for vehicle charging. The amount of power requested would depend primarily on the number of EDVs together with the time period of when this power is requested.

Therefore, from several perspectives in order to appraise the impact of EDVs a primary requirement is a detailed description of how cars are used. In several European countries, national or local bodies (e.g. statistical offices, ministries for transport) carry out travel

surveys. Even though in some cases such surveys are detailed enough to derive car usage profiles, in many cases only aggregate information is available. Therefore additional data is needed. As part of a study launched by the Institute for Energy and Transport of the Joint Research Centre of the European Commission, in the spring of 2012 a sample survey was carried out in six European countries to investigate the driving behavior of European car drivers. The survey was based on a web-based self-administered travel diary covering a period of 24 hours for 7 days. From the outcome of this survey, car usage patterns can be analyzed under various perspectives.

This report is a part of a larger study that aims at building a database of load profiles for electric drive vehicles based on car use profiles in six countries (France, Germany, Italy, Poland, Spain and United Kingdom). These six Member States in 2011 represented more than 75% of the total new sales of passenger cars in EU. The study was performed by the JRC together with TRT and Ipsos. More details on the attitude of European car drivers towards electric vehicles as well as the revealed "ideal" composition of such a vehicle with respective potential policy implications can be found in the report on "Attitude of European car drivers towards electric vehicles: a survey" (Thiel et al, 2012).

This report presents driving habits drawn from the survey results which are more significant in relation to the subsequent study activities on the use of electric vehicles. The structure of the report is the following. Section 2 describes the methodological aspects of the survey, providing details on the sample, the pilot phase, the extended fieldwork phase and the quality checks on results. In section 3, a comparison between the outcome of the survey and the national travel surveys data of UK and Germany is conducted in order to validate the results. Section 4 provides some descriptive statistics about the derived car usage information by employing the data obtained through the survey.The full text of the questionnaire used in the survey as well as the texts of the communications with the panelists are provided in the annex.

2 The direct survey

Before the direct survey, we conducted a meta-analysis of National Travel Surveys (NTS) of the United Kingdom, Germany, France, Spain and Italy to determine their sufficiency for analysing the potential impacts of EDVs on the European electricity system. Throughout the meta-analysis, we assessed the national travel surveys against the presence/absence and completeness of information regarding the criteria table illustrated in Table 2-1

Table 2-1 Criteria Table

Description of data	**Requirement**
Type	Trip diaries
Aggregation	Individual data
Surveyed period	7 days - 24 hours
Parking details	Duration and place
Individual details	Information on socio-economic features
Vehicle details	Vehicle size and age
Living Area	Segmentation in rural and urban area
Geographical Coverage	Entire country

The conducted analysis reveals that only the UK National Survey matches the data needs in order to conduct a comprehensive scenario analysis for the EDV recharge profiles.
On the other hand, the German NTS has a similar level of detail as the UK NTS but does not include each individual's trips for an entire week and misses details for parking (where and how long cars remain parked during the day). The remaining national travel surveys present the data only at aggregated level. This kind of data can be used to identify different travel behaviors across different conditions (e.g. for different population groups or different areas) but is not helpful to derive representative driving patterns for cars
Due to this reason and in order to ensure comparability across Member States, we conducted our own mobility surveys for aforementioned member states. The remaining part of section 2 presents a detailed description of how the direct survey was performed in the six European Member States.

2.1 Definition of the reference universe

The survey generated a wide-ranging debate as to how to identify the reference universe for the study. Since the task was to carry out a survey of the car-driving population, the ideal universe of reference would have been a part of the population holding a driving license and regularly driving a car. However, the socio-demographic characteristics of this car-driving population are basically not known, due to the lack of detailed data (furthermore, existing data is not uniformly available in all the countries covered by the study). Generally available information is the socio-demographic composition of the population in age.

From the data of the NTS in the UK and Germany, some comparisons between the composition of the overall population and of the population of car drivers can be made. Comparisons are summarized in the figures below (Figure 2.1 to Figure 2.4).They show that even if there are some differences, the profile of the two populations is reasonably similar.

Therefore, it was assumed that the profile of people holding a driving license and driving a car does not significantly differ from the universe of the people across age profiles. This way the population over 18 years of age could be considered as the best possible approximation to that ideal universe and taken as the operating reference universe for the survey, i.e. the basis for constructing the theoretical sample in terms of quotas. This decision was considered as the best possible balance between the knowledgeable universe and the ideal universe (which cannot be known in advance).

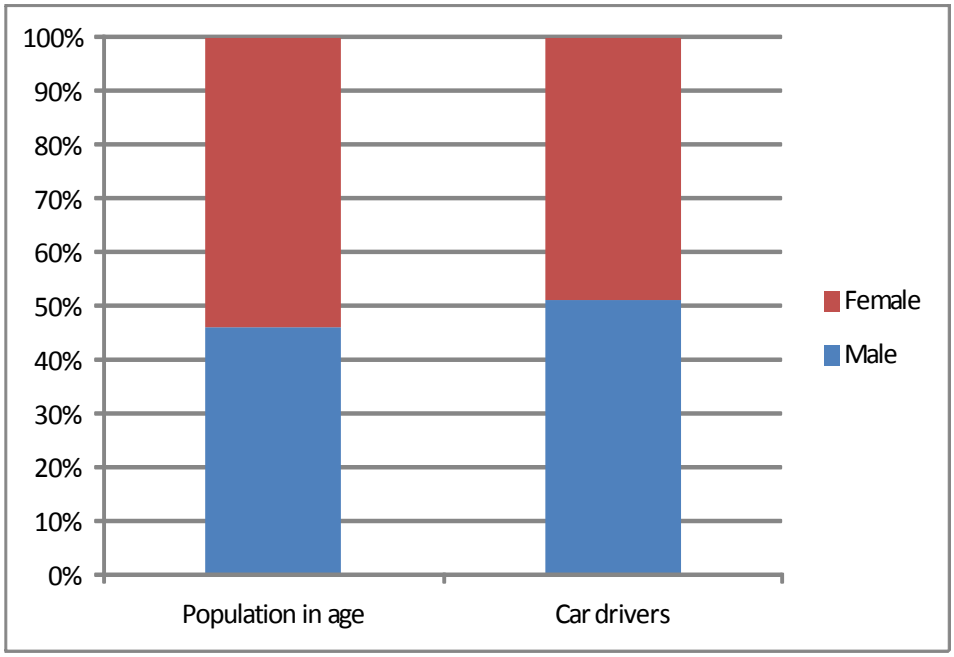


Figure 2.1 Comparison of population composition by gender in Germany. Source: derived from German NTS (MID-2008) and EUROSTAT data1,2

[1] Population in age is 18 years or older

[2] For detailed Statistical data sources see Annex II.

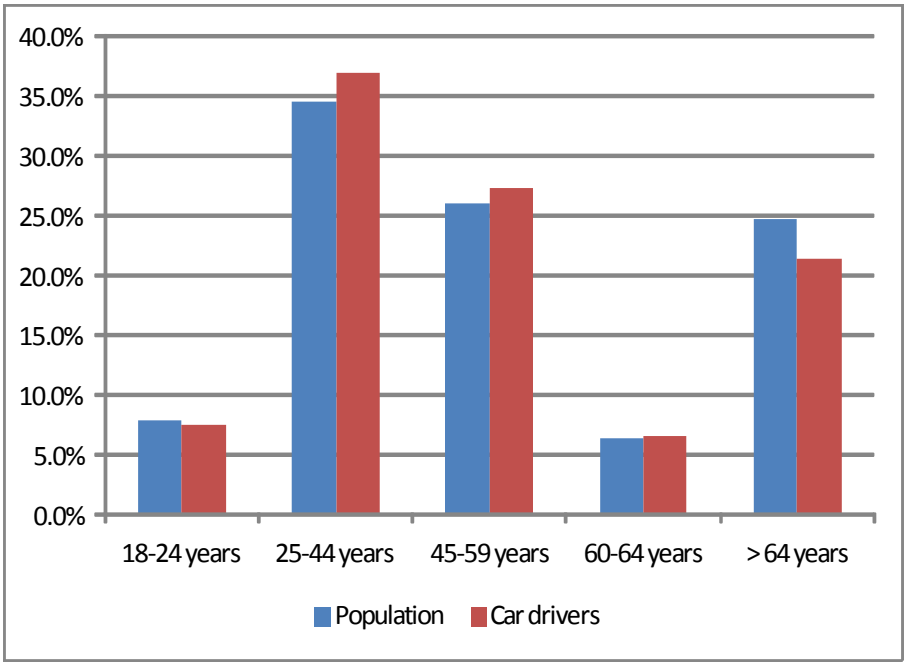


Figure 2.2 Comparison of population composition by age in Germany. Source: derived from German National Travel survey (MID-2008) and EUROSTAT3

[3] For detailed Eurostat sources see Annex II.

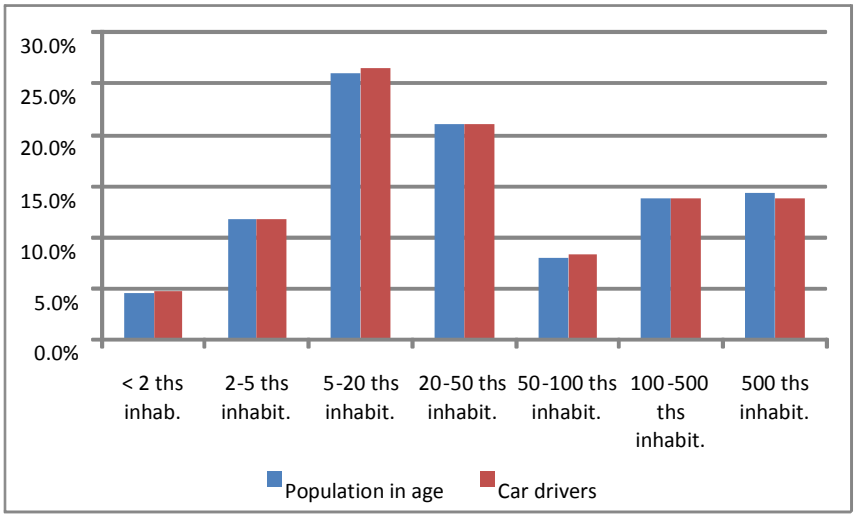


Figure 2.3 Comparison of population composition geographical area in Germany Source: Derived from Germany National Travel survey (MID-2008) and EUROSTAT data4

[4] For detailed Eurostat sources see Annex II

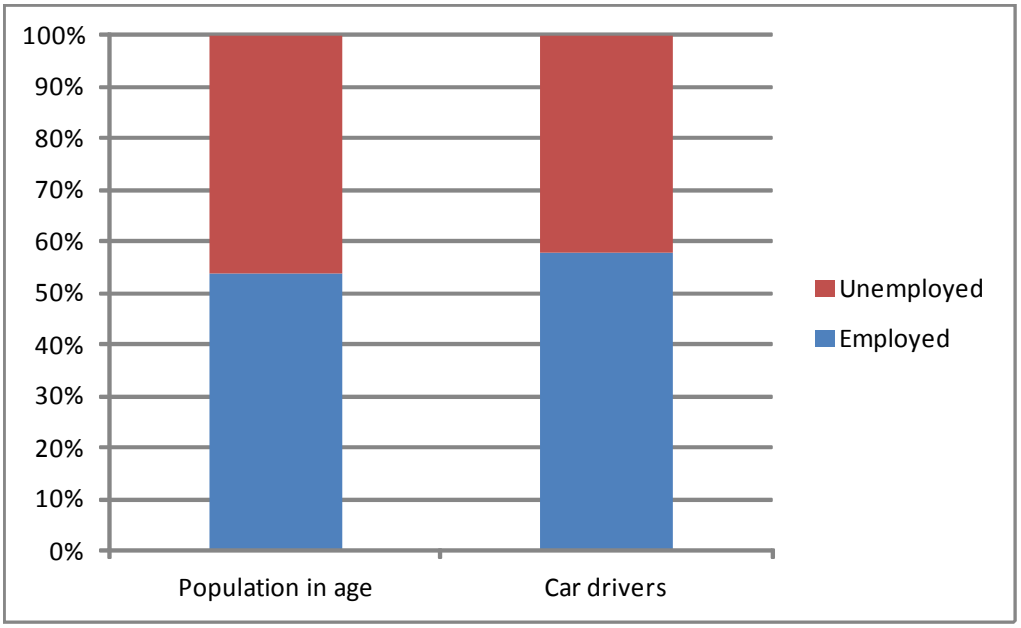


Figure 2.4 Comparison of population composition professional status in UK Source: Derived from UK National Travel survey (UK NTS-2008) and EUROSTAT data5

The initial construction of the theoretical sample to be used for the main survey took the following elements into account:

- The size of the total samples required, i.e., 600 cases for each country.
- The number of interviews carried out during the pilot phase (different from country to country, see section 2.2).
- The number of cases to be used for oversampling (also different from country to country, depending on the number of cases obtained during the pilot).

Basically 500 individuals were considered as sufficient to represent the national sample. The total sample size of 600 was reached considering the interviews completed during the pilot phase and the additional individuals for oversampling frequent car users. The sample size of 600 individuals for each country was chosen according to the budget available for the study. When a sample survey is organized for estimating a specific variable (e.g. the proportion of population holding a certain preference) the definition of the sample size can be based on the desired confidence interval for the estimator. This survey was aimed at collecting a number of different items (e.g. the share of individuals making more trips per day, the share of individuals parking on kerbside and so forth) describing the driving habits of the individuals. Therefore the sample size can be hardly based on considerations

[5] For detailed Eurostat sources see Annex II

regarding the confidence interval of estimations. Notwithstanding, if one think of the survey as focused on given indicators, an indicative confidence interval for the estimates provided by the sample size of 600 individuals can be identified.
Namely, if the target variable is e.g. the proportion of drivers making n trips per day, assuming that this proportion is totally unknown a priori (and so in the worst case) a random sample of 600 individuals can provide the estimation of this proportion with a confidence interval of 0.04 in the 95 of the cases. This means that if the estimated proportion is 20%, the confidence interval will be 16-24%. Since the sample is stratified rather than a pure random one, the interval can be narrower.
Instead, if we consider the estimation of an average value (e.g. the average number of trips per day), assume that the distribution of this variable in the population is a Normal with a standard deviation of 2.4, a random sample of 600 individuals provides the estimation of the average number of trips per day with a confidence interval of ± 0.2 trips in the 95% of the cases. Again, since the sample is stratified, the interval can be reduced. However, the distribution of trips is not symmetrical so the interval indicated is only indicative.
In each country, it was decided to oversample the subjects who used a car often (every day or nearly every day) as they are the most relevant to provide the required information on driving profiles. Car use frequency was ascertained during the interview, by means of a filtering question.
The following table summarizes the structure of the sample in each country.

Table 2-2 Structure of the sample by country

	France	Germany	Italy	Poland	Spain	UK
Total interviews to be conducted	600	600	600	600	600	600
Pilot stage (completed)	43	16	25	11	17	17
To be conducted during main survey	557	584	575	589	583	583
National representative sample	500	500	500	500	500	500
Oversampling	57	84	75	89	83	83

2.2 Sample stratification

Quota samples were set for the 500 individuals of the national representative sample. For the oversample no identification criteria were set, other than regular car use on a daily basis, because the unique purpose of the oversample was to increase the number of frequent car users.

The following stratification criteria were used in each country:

- Gender by age group (2 methods * 3 age ranges)
- Geographical area (with a definition which is slightly different from country to country depending on the geographic composition of the country)
- City size (with a definition which is slightly different from country to country depending on the geographic composition of the country)
- Level of education (degree/no degree)
- Occupational status (in work vs. not in work)

The stratification variables related to the level of education and occupational status were set as "soft quotas", that is, a margin of oscillation was allowed around the predefined strata size required.

In setting the theoretical sample, it was further decided to opt for non-proportional distribution in relation to the universe, for the demographic variables of gender by age groups, level of education, and occupational status. The reason was to facilitate the interpretation of the data (i.e. by increasing the sample size of strata which otherwise would be very small) and on the other it maintained homogeneity between the various countries, enabling them to be compared. In relation to the education and employment status there was another reason for a non-proportional distribution of the sample. i.e. that the proportions of the knowledgeable universe (based on the available official sources)

underestimate the share of occupied and educated people because they include underage inhabitants.
The size of the strata in the population was estimated based on several sources. As far as possible the same source (namely EUROSTAT) was used across countries for the sake of homogeneity and comparability. However, in many cases EUROSTAT statistics are not detailed enough for the purposes of the estimation and national sources were used instead. For the full references on Eurostat and national statistics refer to Annex 2.
The following tables set out the stratification of the main sample in each country in comparison to the composition of the population.

Table 2-3 Stratification of the sample by gender and age group

	Male			Female			Total		
	Sample	**Sample share**	**Pop share**	**Sample**	**Sample share**	**Pop share**	**Sample**	**Sample share**	**Pop share**
France									
18-34	80	16.0%	13.6%	80	16.0%	13.5%	160	32.0%	27.1%
35-54	95	19.0%	17.2%	90	18.0%	17.6%	185	37.0%	34.8%
55+	78	15.6%	16.9%	77	15.4%	21.2%	155	31.0%	38.1%
Total	**253**	**51.0%**	**47.7%**	**247**	**49.0%**	**52.3%**	**500**	**100.0%**	**100.0%**
Germany									
18-34	78	15.6%	12.3%	75	15.0%	11.9%	153	31.0%	24.2%
35-54	95	19.0%	18.5%	90	18.0%	17.9%	185	37.0%	36.4%
55+	82	16.4%	17.8%	80	16.0%	21.6%	162	32.0%	39.4%
Total	**255**	**51.0%**	**48.6%**	**245**	**49.0%**	**51.4%**	**500**	**100.0%**	**100.0%**
Italy									
18-34	75	15.0%	12.0%	73	14.6	11.6	148	29.6	23.6
35-54	89	17.8%	18.4%	92	18.4	18.6	181	36.2	37.0
55+	88	17.6%	17.6%	83	16.6	21.8	171	34.2	39.4
Total	**252**	**50.4%**	**48.0%**	**248**	**49.6**	**52.0**	**500**	**100.0**	**100.0**
Poland									
18-34	88	17.6%	16.8%	95	19.0%	16.2%	183	36.6%	33.0%
35-54	90	18.0%	16.7%	92	18.4%	16.9%	182	36.4%	33.6%
55+	75	15.0%	14.1%	60	12.0%	19.3%	135	27.0%	33.4%
Total	**253**	**50.6%**	**47.6%**	**247**	**49.4%**	**52.4%**	**500**	**100.0%**	**100.0%**
Spain									
18-34	82	16.4%	14.3%	81	16.2%	13.7%	163	32.6%	28.0%
35-54	87	17.4%	19.1%	90	18.0%	18.7%	177	35.4%	37.8%
55+	81	16.2%	15.4%	79	15.8%	18.8%	160	32.0%	34.2%
Total	**250**	**50.0%**	**48.8%**	**250**	**50.0%**	**51.2%**	**500**	**100.0%**	**100.0%**
UK									
18-34	82	16.4%	14.7%	81	16.2%	14.2%	163	32.6%	28.9%
35-54	90	18.0%	17.4%	88	17.6%	17.8%	178	35.6%	35.2%
55+	79	15.8%	16.6%	80	16.0%	19.3%	159	31.8%	35.9%
Total	**251**	**50.2%**	**48.7%**	**249**	**49.8%**	**51.3%**	**500**	**100.0%**	**100.0%**

Source: Derived from EUROSTAT data

Table 2-4 Stratification of the sample by geographical area

Country/Region	Sample	Sample Share	Pop share
France			
Île-de-France	94	18.8%	18.8%
South-west and West	123	24.5%	24.5%
Centre-east & Mediterranean	122	24.6%	24.6%
North: Pas de Calais and East	75	15.0%	15.0%
Paris Basin	86	17.1%	17.1%
Total	**500**	**100.0%**	**100.0%**
Germany			
Hamburg, Bremen, Schleswig-Holstein, Lower Saxony	81	16.1%	16.1%
North Rhine-Westphalia	109	21.9%	21.9%
Hesse, Rhineland-Palatinate, Saarland	68	13.6%	13.6%
Baden-Württemberg	66	13.1%	13.1%
Bavaria	76	15.3%	15.3%
Berlin	21	4.2%	4.2%
Mecklenburg-Western Pomerania, Brandenburg, Saxony-Anhalt+Thuringia, Saxony	79	15.8%	15.8%
Total	**500**	**100.0%**	**100.0%**
Italy			
North West	133	26.6%	26.6%
North East	96	19.2%	19.2%
Centre	98	19.7%	19.7%
South & Islands	173	34.5%	34.5%
Total	**500**	**100.0%**	**100.0%**
Poland			
Centralny	102	20.3%	20.3%
Poludniowy	104	20.8%	20.8%
Wschodni	88	17.7%	17.7%
Pólnocno-Zachodni	80	16.0%	16.0%
Poludniowo-Zachodni	51	10.2%	10.2%
Pólnocny	75	15.0%	15.0%
Total	**500**	**100.0%**	**100.0%**
Spain			
North-west and North-east	187	37.4%	37.4%
Madrid and Centre	130	26.0%	26.0%
East	70	14.0%	14.0%
South and Canaries	113	22.6%	22.6%
Total	**500**	**100.0%**	**100.0%**

(continue)

Table 2-5 Stratification of the sample by geographical area (continued)

Country/Region	Sample	Sample Share	Pop share
UK			
Greater London	63	12.6%	12.6%
Midlands	80	16.0%	16.0%
South East & East of England	115	23.0%	23.0%
Scotland + Northern Ireland	56	11.3%	11.3%
North West	56	11.2%	11.2%
North East & Yorkshire	63	12.6%	12.6%
South West & Wales	67	13.3%	13.3%
Total	**500**	**100.0%**	**100.0%**

Table 2-6 Stratification of the sample by occupational status

	Sample	Sample share	Pop share
France			
In work	315	63.0%	48.7%
Not in work	185	37.0%	51.3%
Total	**500**	**100.0%**	**100.0%**
Germany			
In work	312	62.5%	54.7%
Not in work	188	37.5%	45.3%
Total	**500**	**100.0%**	**100.0%**
Italy			
In work	300	60.0%	43.3%
Not in work	200	40.0%	56.7%
Total	**500**	**100.0%**	**100.0%**
Poland			
In work	310	62.0%	48.3%
Not in work	190	38.0%	51.7%
Total	**500**	**100.0%**	**100.0%**
Spain			
In work	300	60.0%	45.6%
Not in work	200	40.0%	54.4%
Total	**500**	**100.0%**	**100.0%**
UK			
In work	310	62.0%	54.6%
Not in work	190	38.0%	45.4%
Total	**500**	**100.0%**	**100.0%**

Source: Derived from EUROSTAT data. Note: soft quotas

Table 2-7 Stratification of the sample by city size

Country/Size	Sample	Sample Share	Pop share
France			
<20.000 inhabitants	217	43.4%	43.4%
20-199.999 inhabitants	93	18.6%	18.6%
200.000 + inhabitants	190	38.0%	38.0%
Total	**500**	**100.0%**	**100.0%**
Germany			
up to 20.000 inhabitants	149	29.7%	29.7%
20.001 - 100.000 inhabitants	74	14.8%	14.8%
100.001 - 500.000 inhabitants	86	17.3%	17.3%
>500.000 inhabitants	191	38.2%	38.2%
Total	**500**	**100.0%**	**100.0%**
Italy			
up to 10.000 inhabitants	155	31.0%	31.0%
10-30.000 inhabitants	121	24.3%	24.3%
30-100.000 inhabitants	106	21.2%	21.2%
>100.000 inhabitants	118	23.5%	23.5%
Total	**500**	**100.0%**	**100.0%**
Poland			
Rural areas	195	39.0%	39.0%
Towns up to 20.000 inhabitants	65	12.9%	12.9%
Towns from 20.001 to 100.000 inh.	97	19.4%	19.4%
Towns >100.000 inhabitants	143	28.7%	28.7%
Total	**500**	**100.0%**	**100.0%**
Spain			
up to 20.000 inhabitants	159	32.0%	32.0%
20-100.000 inhabitants	142	28.3%	28.3%
>100.000 inhabitants	199	39.7%	39.7%
Total	**500**	**100.0%**	**100.0%**
UK			
Up to 100.000 inhabitants	77	15.5%	15.5%
100-500.000 inhabitants	385	77.0%	77.0%
>500.000 inhabitants	38	7.5%	7.5%
Total	**500**	**100.0%**	**100.0%**

Table 2-8 Stratification of the sample by level of education

	Sample	Sample share	Pop share
France			
Graduates	200	40.0%	26.3%
Non-graduates	300	60.0%	73.7%
Total	**500**	**100.0%**	**100.0%**
Germany			
Graduates	200	40.0%	22.6%
Non-graduates	300	60.0%	77.4%
Total	**500**	**100.0%**	**100.0%**
Italy			
Graduates	200	40.0%	13.0%
Non-graduates	300	60.0%	87.0%
Total	**500**	**100.0%**	**100.0%**
Poland			
Graduates	200	40.0%	19.8%
Non-graduates	300	60.0%	80.2%
Total	**500**	**100.0%**	**100.0%**
Spain			
Graduates	200	40.0%	28.1%
Non-graduates	300	60.0%	71.9%
Total	**500**	**100.0%**	**100.0%**
UK			
Graduates	200	40.0%	31.5%
Non-graduates	300	60.0%	68.5%
Total	**500**	**100.0%**	**100.0%**

Source: Derived from EUROSTAT data. Note: soft quotas

2.3 The pilot phase

The pilot phase took place in the period 9th February – 9th March 2012. Originally a shorter period was envisaged, but given the response rates it took more time to get a sufficient number of interviews. The statistics of the pilot fieldwork are reported in Table 2-9

Table 2-9 Statistics of the pilot fieldwork

	France	Germany	Italy	Poland	Spain	UK
Completes	43	16	25	11	17	17
Incompletes	274	59	73	64	67	75
Eliminated by screening	259	78	35	37	71	48
Screened out (diary rules not respected)	110	17	43	26	52	13
Total entries	**686**	**170**	**176**	**138**	**207**	**153**
Invitations	1249	228	442	428	487	235
Response rate [1]	55%	75%	40%	32%	43%	65%
Incidence [2]	14%	17%	42%	23%	19%	26%
Dropped out (incorrect diary keeping) [3]	26%	18%	30%	26%	38%	12%
Expected completion rate [4]	3.4%	7.0%	5.7%	2.6%	3.5%	7.2%

1 = Total entries / invitations

2 = Completes / (complete+eliminated by screening)

3 = Screened out (diary rules not respected) / (Complete +Incomplete + Screened out (diary rules not respected)

4 = Completes / invitations sent

In the four weeks of the pilot phase, a variable number of completed interviews were obtained in the four countries, ranging from the 11 interviews of Poland to the 43 of France.

The response rate was also quite variable; it was higher for UK and Germany and lower especially for Poland. Given the target of valid interviews, other things being equal more invitations are needed where the response rate is low.

The other things are especially interpreted by the incidence, i.e., the share of completed questionnaires, Here the best result was obtained in Italy, while Spain, Germany and France only a relatively low number of panellists was able or available to complete the questionnaire after having accepted to fill it in.

One reason for not completing the questionnaire was that respondents were screened out by the system if they did not fill in the questionnaire in the system within 2 days. This happened more frequently in Italy and Spain and less frequently in Germany and UK.

In summary, the expected completion rate was a first key outcome of the pilot phase as it gave an estimation of how many invitations would be needed to get all the required interviews. This rate was generally low, especially in Spain, France and Poland, while it was larger in Germany and UK but anyway well below 10%.
It should be considered that in the number of questionnaires in the pilot phase also some test respondents were included. Test respondents were selected within the TRT, IPSOS and JRC-IET staff. The questionnaires of the test respondents were NOT included in the final sample, while the other responses obtained in the pilot phase were included to reach the total number of 600 cases in each country.
If the estimate of the completion rate was one key result of the pilot phase, the feedback received about aspects like the format of the questions, the communication with the respondents, the filling in rules were also very important for finalizing the design for the extended fieldwork phase. These aspects are discussed below.

2.3.1 Feedback on the questionnaire

The feed-back on the questionnaire includes different aspects: the functioning of the web-questionnaire, the wording of the questions, the definition used in the questions.
As far as the wording and the definition are concerned, we received a number of requests for changes to the questionnaire. Such requests, especially concerning the translation in the original languages were used to refine the questionnaires for the extended survey. One missing category in the classification of cars by age was detected. A pop up explaining how to describe the parking place (and inviting the respondent to take a few seconds to read each explanation) was added to the questionnaire to reduce misunderstanding on this item.
As for the functioning of the web questionnaires the main issues were:

- some respondents thought the whole questionnaire had to be submitted at once (whereas it was to be sent as three separate parts at three different times),
- some respondents failed to print out the table on which departure time, arrival time, and distance travelled were to be recorded,
- In some cases the third section was not displayed (because those particular respondents had been screened out before they finished the 7-day diary)
- Another issue raised was that some respondents could not access the questionnaire when they made a trip late in the evening, especially if they arrived home after midnight.

These problems were addressed as part of the communication with the panellists and of the filling in rules.

Finally, the "trip schedule" (the document in which respondents were asked to indicate details of each trip made during a specific day) was made available and downloadable also for those having completed the section 1 of the questionnaire.

2.3.2 Feedback on the communication with the respondents

Some respondents in the pilot phase reported that they did not understand when they would be sent reminders. In some cases the wording of the reminders was not very clear (and the reminder was mistaken for a repeat invitation to participate). In other cases reminders were sent, but were deleted without being read, etc,.
In order to ease feedback the differentiation of the invitation letter from the reminders by retaining only the following 3 types of letter:

- the letter of invitation to take part in the survey (day 0 – Section 1 only)
- the letter of invitation to begin keeping the travel diary
- the reminder to keep filling in the travel diary

The templates of these three letters are given as an attachment to this report.
Other modifications: respondents did not receive letters or reminders at weekends. They received a reminder on Friday afternoon and another on Monday morning, in case they had forgotten to fill in the diary for Saturday and/or Sunday. Reminders were sent out every 2 days.
Also the communication of how and when access the questionnaire was adapted as it was verified that this was unclear to some respondents. Namely:

- the letter inviting respondents to start their diary was personalised, and referred to their actual diary start day,
- the "congratulations" message issued on completion of Section 1 was modified,
- a specific message was added on completion of the travel diary to remind that, if the respondent missed to register a previous day he/she could integrate the questionnaire. The message also explained how to be directed to the new diary page,

At the same time, in order to avoid the risk of late evening journeys being missed, respondents were instructed to only access the questionnaire after completing all their journeys for that day and, if they were going to be driving too late in the evening to include that journey in the questionnaire, to record it on the following day so that all journeys would be reported.

2.3.3 Feedback on the fill-in rules

Most of the suggestions/observations/remarks referred to the rules for completing the diary. In particular, the rule asking respondents to connect at least once every two days

(even if they had not driven in those two days) was found inconvenient. As an alternative, it was suggested that respondents should be allowed to fill in all the details of their driving patterns at once, at the end of the seven days.
Adaptations of the fill-in rules to consider the feedback were carefully considered. Basically the message coming from the pilot phase was a confirmation of the expectations: respondents were asked to make a considerable effort and this might dissuade some of them from participating or might induce someone to give up after starting. Nevertheless it was preferred to stick to the rules (e.g., the requirement to connect every two days, even if no car journeys had been made was confirmed) in order to maintain the quality of data collected. Had respondents been permitted to fill in the whole diary at once at the end of the week, the risk of incomplete and/or inaccurate responses would have been too high,
The rules were therefore redefined as follows:

- If after receiving the letter of invitation to participate in the survey, respondents did not log on for at least 2 days, they were SCREENED OUT.
- If respondents started the diary but did not access the diary link for at least the next 3 days, they were SCREENED OUT.
- Respondents were permitted to fill in their diary each day at any time between 4 pm and 12 midnight, including the current day and any days missed, If their last trip of the day ended after midnight, or too late for them to record it in the diary, they were instructed to enter it the following day,
- If respondents kept the diary but did not drive a car for 7 days they were SCREENED OUT.

2.3.4 Conclusions from the pilot phase

The pilot survey proved highly useful because it showed that there were several ways in which the questionnaire and the organisation of the survey could be improved. Corrective actions were defined and implemented before the main survey was launched.
A low response ratio was recorded for the pilot, suggesting that the respondents were challenged by the complexity of the survey. Corrective action was difficult to put into practice, since this complexity was due to the amount of information and detail required. Since increasing the incentives would not have encouraged the respondents to make a greater commitment, the only response possible was to sharply increase the number of invitations.

2.4 The extended fieldwork phase

The full extended fieldwork started on 21st March in all countries. The duration was instead different from country to country. As expected after the pilot phase, a relatively low

response rate was encountered for the main survey, which in fact took longer than originally planned. Table 2-10 gives the survey start and finish dates for the various countries involved.

Table 2-10 Duration of the extended fieldwork by country

	Fieldwork start	Fieldwork end	Total fieldwork days
France	21 March	17 April	28
Germany	21 March	2 May	43
Italy	21 March	17 April	28
Poland	21 March	07 June	79
Spain	21 March	18 May	59
UK	21 March	21 May	62
		Average no, of days	**49.8**

The average duration was 49.8 days, longer for the UK, Spain and Poland, but under a month for France and Italy (28 days).
The total number of invitations sent to all the countries was 160,682, subdivided as shown in Table 2-11.

Table 2-11 Invitations and completion rate by country

	France	Germany	Italy	Poland	Spain	UK	Total 6 countries
total interviews	623	606	613	548	617	716	3723
No, of invitations sent	30,490	13,515	24,952	57,830	14,431	19,464	160,682
% of total invitations	19.0%	8.4%	15.5%	36%	9.0%	12.1%	100%
completion rate	2.0%	4.5%	2.5%	0.9%	4.3%	3.7%	2.3%

The average completion rate (i.e. the relationship between invitations sent and questionnaires completed) was even lower than in the pilot phase. On average it was slightly higher than 2% (Table 2-11), Germany and Spain were above the average (but still below the rate shown in the pilot) while the response rate for Poland was particularly low. However an analysis based on the total invitations sent out does not give a complete

picture of how the survey progressed because as the following table shows, the invitations were sent out to different countries at different times, like exemplified in Table 2-12.

Table 2-12 Invitation waves for Germany

GERMANY SAMPLE	
Invitation day	*Invitation count*
*09 Feb**	*182*
*16 Feb**	*46*
*21 Feb**	*128*
21 March	4,043
27 Mar	4,275
03 Apr	4,841
Total invitations Germany	**13,515**

** invitations sent out during the pilot*

The low completion rate can be explained by the high level of complexity of the questionnaire. The reduced completion rate with respect to the pilot phase is a possible outcome during this type of surveys.

First, it should be kept in mind that there are important behavioural differences not only between countries, but between panel members in individual countries. These differences in attitude have a strong influence on the factor usually referred to as "the expected response rate", which can therefore extremely vary even within the same country for two different batches of invitations (for example, 1000 French panellists might be invited and a certain number of completed returns received, but the same pattern may not necessarily repeat with a second batch of 1000 more French panellists).

In the end, no expected response rate is "absolutely valid", since the response rate has a "dynamic" trend that is greatly influenced not only by the attitude of this or that particular panellist but also by the level of commitment required. So in addition to the factors just described, every time the sampling team pulls out a new batch of names it takes account of the yield (in terms of interviews completed) obtained from the previous batch.

Since the sampling team makes an assumption about the expected response rate, it takes a number of factors into account, such as the complexity of the commitment expected from the respondent, the availability of this or that particular panel, the quota samples, and the overall composition of the panel (so that a hypothesis can be made as to which segments of the population may prove to be numerically insufficient during the fieldwork).

In general, the algorithm used by the IPSOS Interactive Services sample team is a fairly efficient tool for predicting the expected response rate. However, as the conducted survey required a very high level of continuous commitment of the respondent, for several consecutive days, it did not work as expected.

The need to manage a weekly diary makes it more difficult to obtain an accurate prediction of how panellists may behave over several days. It was necessary to wait for a few days to ascertain whether panellists had completed their diaries and were being cooperative or not, to understand if and why any of them had been screened out, and then issue a new reminder or exclude them and replace them with a new panellist.
The strategy adopted, especially in the case of the most loyal panels for which the response rate was higher (United Kingdom, France, and Germany), was to wait and then re-invite the panellists several times before excluding them from the survey. Conversely, in the case of smaller panels or panels that had a less well-established habit of participation (such as Poland or to a lesser extent, Spain), the most important difference encountered was in a lower level of collaboration and a lower level of ability to design a targeted sample, which increased the number of drop-outs due to ineligibility.
The case of Poland represents a clear example of the extreme complexity of this survey. Table 2-13 shows the detailed statistics of the extended fieldwork for this country.

Table 2-13 Extended fieldwork statistics for Poland

Invitations sent	57,830
Link accessed	14,335
Screened out at the preliminary stage	5,862
Screened out because of failure to respect diary rules	1,899
Dropped due to diary failure	5,294
Completes (6 and 7 days)*	548
Response rate (number of entries/number of invitations)	24.8%
Incidence (number of completes/completes+ screened out at preliminary stage)	8.5%
Drop rate (incompletes/no, of entries)	36.9%
Dropped during diary (dropped during diary stage + screened out at diary stage/completes+screened out during diary stage+incomplete diary)	92.8%

** including diaries completed up to day 6 or 7*

The largest number of invitations was sent to Poland, given the low response rate registered in the pilot phase. However, in the extended phase the response rate was even lower than expected (-7% as compared to the pilot). Furthermore, also the incidence suffered a dramatic collapse as compared to the pilot (-15%).
In relation to the extremely large number of invitations sent out, the low response rate was determined by two factors:
1) the degree of commitment, which was deemed excessive by the panellists,
2) the panellists were not in the habit of taking part in projects of such complexity.

As for the first of these two factors is concerned, the larger panels (France, United Kingdom, Germany, Italy) had previously taken part in many diary surveys and their panellists were experienced to this type of commitment and its benefits. In Poland people were not so used to it, and expected to make less effort than was requested from them.
As for the second factor, the requirements placed on the panellists (the need to record all the information about their car, its mileage, and distances travelled each trip, each day) were considered too difficult and time-consuming; there were too many diary sheets to print out; some panellists considered that even when using a diary sheet, there was still too much information to be filled in.
In terms of communication, the Polish respondents were kept clearly informed about every aspect; they were given the table to fill in with the data, and the questionnaire was very clear about what they were being asked to do. But the data they were asked to record was difficult to manage, particularly in the case of busy people who were expected, every time, to record the kilometres marked on their counter, their departure and arrival times for every journey, etc.
To give the panellists a greater sense of involvement, each was individually reminded about the survey and the importance of its end goal. Those already keeping diaries were given daily reminders to make sure that they stuck to the rules and did not screen themselves out. In several cases direct feedback was sought so that opinions could be gathered about the survey.
Despite the daily prompts, the valid respond number for Poland was still lower than what had been foreseen. However, as the entire IPSOS panellist database for Poland was already used, it was decided to close the survey with a lower number of responds for Poland than what had been planned for.
To increase the available number of responses it was also decided to consider valid the interviews where one or two days were missing (they were 154 in total, of which 148 were missing the last day of the diary, while in the remaining 6 cases the last day of the diary was compiled but the next questions were not). However, it is worth to noticing that this choice has not significantly biased the results of the survey for Poland. The detailed presentation and explanation about this issue is given in section 4.

2.4.1 Structure of the actual sample

A total of 3.723 interviews was carried out in the 6 countries considered, of which 129 were carried out during the pilot and 3.594 during the main survey, 3.000 interviews are the base sample (i.e., the representative sample) while 594 interviews are the oversample. Detailed figures by country are given in Table 2-14 below.

Table 2-14 Actual sample structure by country

	FR		DE		IT		PL		SP		UK	
	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%
Pilot	43	6.9	16	2.6	25	4.1	11	2.0	17	2.8	17	2.4
Representative	500	80.3	500	82.5	500	81.6	500	91.2	500	81.0	500	69.8
Oversample	80	12.8	90	14.9	88	14.4	37	6.8	100	16.2	199	27.8
Total	**623**	**100**	**606**	**100**	**613**	**100**	**548**	**100**	**617**	**100**	**716**	**100**

The stratification of the actual sample is different from the strata size presented in section 2.1 for different reasons.

First, in order to obtain a better representation of the phenomenon under study, during the construction of the theoretical sample a methodological decision was taken to move further away from the universe of reference by taking a non-proportional approach to some socio-demographic characteristics (gender, age groups, occupational status, and level of education) and to oversample frequent car users.

Second, the eligibility criteria adopted for the survey (in order to provide a better understanding of the mobility profiles) produced a misalignment with respect to the theoretical universe of departure because *de facto* they "naturally" brought to over-represent some segments of the population (those who were most active in work, most highly educated, and youngest). From a different perspective this misalignment depends on the difference in structure between the ideal universe (car drivers) and the knowledgeable universe (people in age).

The difference between the theoretical and the actual sample is manageable by means of weighting as explained in the following subsection.

Table 2-15 compares the planned and actual sample by country.

Table 2-15 Comparison of theoretical and actual sample by gender and age

FRANCE	*Theoretical sample (No,=500)*				*Actual sample*		
%	Male	Female	TOT		Male	Female	TOT
18-34	16.0	16.0	32.0		16.5	17.2	33.7
35-54	19.0	18.0	37.0		17.3	18.9	36.3
55+	15.6	15.4	31.0		13.0	17.0	30.0
Total	**51.0**	**49.0**	**100.0**		**46.9**	**53.1**	**100.0**

GERMANY	*Theoretical sample (No.=500)*				*Actual sample*		
%	**Male**	**Female**	**TOT**		**Male**	**Female**	**TOT**
18-34	15.6	15.0	31.0		15.7	13.0	28.7
35-54	19.0	18.0	37.0		21.9	19.6	41.6
55+	16.4	16.0	32.0		15.7	14.0	29.7
Total	**51.0**	**49.0**	**100.0**		**53.3**	**46.7**	**100.0**

ITALY	*Theoretical sample (No.=500)*				*Actual sample*		
%	**Male**	**Female**	**TOT**		**Male**	**Female**	**TOT**
18-34	15.0	14.6	29.6		16.2	15.3	31.5
35-54	17.8	18.4	36.2		15.3	21.9	37.2
55+	17.6	16.6	34.2		16.2	15.2	31.3
Total	**50.4**	**49.6**	**100.0**		**47.6**	**52.4**	**100.0**

POLAND	*Theoretical sample (No.=500)*				*Actual sample*		
%	**Male**	**Female**	**TOT**		**Male**	**Female**	**TOT**
18-34	17.6	19.0	36.6		13.7	26.5	40.1
35-54	18.0	18.4	36.4		21.4	26.5	47.8
55+	15.0	12.0	27.0		6.4	5.7	12.0
Total	**50.6**	**49.4**	**100.0**		**41.4**	**58.6**	**100.0**

SPAIN	*Theoretical sample (No.=500)*				*Actual sample*		
%	**Male**	**Female**	**TOT**		**Male**	**Female**	**TOT**
18-34	16.4	16.2	32.6		14.3	17.2	31.4
35-54	17.4	18.0	35.4		22.5	32.9	55.4
55+	16.2	15.8	32.0		7.6	5.5	13.1
Total	**50.0**	**50.0**	**100.0**		**44.4**	**55.6**	**100.0**

UK	*Theoretical sample (No.=500)*				*Actual sample*		
%	**Male**	**Female**	**TOT**		**Male**	**Female**	**TOT**
18-34	16.4	16.2	32.6		8.1	10.3	18.4
35-54	18.0	17.6	35.6		15.6	16.5	32.1
55+	15.8	16.0	31.8		24.2	25.3	49.4
Total	**50.2**	**49.8**	**100.0**		**47.9**	**52.1**	**100.0**

In relation to gender and age distribution (Table 2-15) the UK actual sample, compared to the theoretical sample, shows an imbalance for the younger part of the population (18-34 years) which is under-represented, and a more or less even balance between males and females, with a slight predominance of the latter.
The actual sample for Italy is well balanced with the theoretical sample, and the deviations are minimal. Once again there is a predominance of females. In the actual sample for Spain, the largest deviation as compared to the theoretical sample is found in the upper age ranges. There are fewer elderly subjects and a higher proportion of individuals aged between 35 and 54. Once again females are prevalent. The actual sample for Germany is well balanced with the theoretical sample, and the deviations detected are small. The actual sample for France shows only small differences as compared to the theoretical sample, with a slightly greater presence of females. For Poland, the most noticeable deviations between the theoretical sample and the actual sample fall within the upper age range (55+) and the middle range (35-54). The presence of females is more marked as compared to males.
Overall we can say that in countries where the deviations between the theoretical sample and the actual sample are more obvious (United Kingdom, Spain and Poland) the distribution by gender and age tends to slightly penalise the upper age group (55+) except in the UK where this age group predominates. This imbalance is partly due to the nature of the survey, which basically favours the more "active" age ranges (in terms of work and lifestyle), since the essential factor for access is that car use must be regular rather than sporadic. In part it is due to the smaller number of elderly subjects who are also internet users.
In terms of geographical distribution (Table 2-16), the UK actual sample shows only slight deviations from the theoretical sample and these are of no significance. The actual sample for Italy is well balanced with the theoretical sample. The sample for Spain shows clear territorial deviations from the theoretical sample, particularly for the north (north-west and north-east), which is under-represented as compared to the east of the country. For Germany, the table shows a good overall distribution of the actual sample, with negligible minor deviations from the theoretical sample. For France, too, only minimal deviations from the theoretical sample are detected; Île-de-France is slightly under-represented. For Poland the table again shows a fairly even balance between the actual sample and the theoretical sample. The deviations are concentrated in two main areas: Południowy (the south) which is slightly over-represented as compared to Wschodni (the east). But again, these deviations are not likely to significantly affect the data.
Overall, the territorial distribution is very good. Except for the two areas of Spain mentioned above, where the differences are more marked, in the other countries the distribution of the sample is completely satisfactory and free of discursive elements.

As for the size of the city of residence is concerned, the distribution of the actual sample as compared to the theoretical sample is optimal for 4 countries out of 6: UK, Italy, Germany and France (Table 2-17). Spain and Poland, on the other hand, show significant differences for particular areas: in both countries the larger towns and cities (> 100 thousand inhabitants) are over-represented at the expense (in the case of Poland) of rural areas and (in the case of Spain) small places. The most reliable explanation of these differences is related to the methodology used: most probably internet access has a greater effect in the more highly developed cities and towns, and conversely penalises the smaller places.

Table 2-16 Comparison of theoretical and actual sample by geographical area

	Theoretical sample (No,=500)	*Actual sample*
FRANCE		
Île-de-France	18.8	16.5
South-west and West	24.5	25.8
Centre-east & Mediterranean	24.6	24.7
North: Pas de Calais and East	15.0	15.6
Paris Basin	17.1	17.3
Total	**100.0**	**100.0**
GERMANY		
Hamburg. Bremen. Schleswig-Holstein. Lower Saxony	16.1	15.8
North Rhine-Westphalia	21.9	21.0
Hesse. Rhineland-Palatinate. Saarland	13.6	14.0
Baden-Württemberg	13.1	12.4
Bavaria	15.3	15.8
Berlin	4.2	3.6
Mecklenburg-Western Pomerania. Brandenburg. Saxony-Anhalt+Thuringia. Saxony	15.8	17.3
Total	**100.0**	**100.0**
ITALY		
North West	26.6	27.2
Nord East	19.2	19.2
Centre	19.7	19.6
South & Islands	34.5	33.9
Total	**100.0**	**100.0**

POLAND (Original Language)		
Centralny	20.3	19.9
Poludniowy	20.8	24.6
Wschodni	17.7	14.1
Pólnocno-Zachodni	16.0	15.7
Poludniowo-Zachodni	10.2	9.3
Pólnocny	15.0	16.4
Total	**100.0**	**100.0**

SPAIN		
North-west and North-east	37.4	21.7
Madrid and Centre	26.0	29.8
East	14.0	24.3
South and Canaries	22.6	24.1
Total	**100.0**	**100.0**

UK		
Greater London	12.6	9.2
Midlands	16.0	11.7
South East & East of England	23.0	17.7
Scotland + Northern Ireland	11.3	11.3
North West	11.2	14.8
North East & Yorkshire	12.6	16.6
South West & Wales	13.3	18.6
Total	**100.0**	**100.0**

Table 2-17 Comparison of theoretical and actual sample by city size

	Theoretical sample	Actual sample
FRANCE		
<20,000 inhabitants	43.4	44.6
20,001-199,999 inhabitants	18.6	18.3
200,000 inhabitants, and over	38.0	37.1
Total	**100.0**	**100.0**
GERMANY		
Up to 20,000 inhabitants	29.7	30.7
20,001-100,000 inhabitants	14.8	14.4
100,001-500,000 inhabitants	17.3	17.5
>500,000 inhabitants	38.2	37.5
Total	**100.0**	**100.0**
ITALY		
Up to 10,000 inhabitants	31.0	30.3
10,001-30,000 inhabitants	24.3	24.6
30,001-100,000 inhabitants	21.2	21.0
>100,000 inhabitants	23.5	24.0
Total	**100.0**	**100.0**
POLAND		
Rural areas	39.0	15.3
Urban areas up to 20,000 inhabitants	12.9	10.8
Urban areas from 20,001 to 100,000 inhabitants	19.4	22.6
Urban areas >100,000 inhabitants	28.7	51.3
Total	**100.0**	**100.0**
SPAIN		
Up to 20,000 inhabitants	32.0	23.5
20,001-100,000 inhabitants	28.3	26.6
>100,000 inhabitants	39.7	49.9
Total	**100.0**	**100.0**
UK		
Up to 100,000 inhabitants	15.5	15.6
from 100,001-500,000 inhabitants	77.0	75.4
>500,000 inhabitants	7.5	8.9
Total	**100.0**	**100.0**

As far as level of education is concerned, the actual sample tends to align with the theoretical sample (Table 2-18). It should also be noted that the deviations shown are determined by the fact that level of education and occupational status were only control quotas, and that a margin of flexibility was possible.
Concerning the occupational status, for all the countries (except the UK, where there was a greater concentration of subjects in the upper age range) the actual sample (as compared to the theoretical sample) shows a clear prevalence of subjects in work (Table 2-19). Despite some significant differences in a number of cases, this higher number of subjects in work is determined by one of the conditions of eligibility that were defined for the survey, namely the daily (or almost daily) car use. It is in fact highly likely that car use is closely correlated with occupational status and that because of this, there is a preference for the "active" component of the population. So regardless of the deviations detected, the greater presence of individuals in work is an important quality factor so far as the objective of the survey is concerned.

Table 2-18 Comparison of theoretical and actual sample by education level

THEORETICAL SAMPLE (No,=500)	FR	GER	IT	PL	SP	UK
Graduates	40.0	40.0	40.0	40.0	40.0	40.0
Non-graduates	60.0	60.0	60.0	60.0	60.0	60.0
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

ACTUAL SAMPLE	FR	GER	IT	PL	SP	UK
Graduates	44.1	32.8	53.8	51.3	40.8	41.9
Non-graduates	55.9	67.2	46.2	48.7	59.2	58.1
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-19 Comparison of theoretical and actual sample by occupational status

Country	Theoretical sample		Actual sample	
	In work	Not in work	In work	Not in work
France	63.0	37.0	64.2	35.8
Germany	62.5	37.5	73.1	26.9
Italy	60.0	40.0	59.9	40.1
Poland	62.0	38.0	79.7	20.3
Spain	60.0	40.0	76.8	23.2
United Kingdom	62.0	38.0	58.2	41.8

2.4.2 A balance of the survey

Since the ideal reference population is unknown in size and composition, the sampling procedure and the subsequent weighting procedure required careful consideration and generated a degree of complexity in the organisation of the survey, for instance the identification of sources to estimate the composition of the population.
It is indisputable that there is a difference between the population taken as reference (people in age) and the ideal universe (car users). However, this is not expected to weaken the representativeness of the results, also in the light of the positive results from the comparisons made with the National Travel Survey data for Germany and UK.
The response rates registered are quite low and their consequence was that the survey lasted more than planned. The complex methodology used for the survey (a diary which each respondent was expected to maintain for 7 days together with a final section that also had to be completed, making a total of 8 days), required considerable commitment that was beyond the willingness of many respondents, The deviations detected (including those encountered in Poland and Spain, which in any case only affected a limited number of specific variables) should be seen as the predictable effects of a precise, carefully considered methodological decision, and do not significantly affect the quality of the result.

2.5 Weigting and expandingthe survey results

2.5.1 Weighting the survey results

Weighting is a statistical procedure applied during analysis of results as a way of rebalancing the correct proportions of the sample, returning them to the (known) characteristics of the reference universe.
For analysis of the results to be correct, each quota sample receives its own specific weighting consisting of the ratio between the theoretical share in the universe and the share in the actual survey. For example: if *U* is the quota that relate to the reference universe, *S* is the quota that relate to the sample, and *W* is the final weighting of each segment, the weighting formula is given simply by the relationship between the universe and the sample, i.e., W = U / S.
If the structures of the actual sample full matches with the reference universe, each case have a weight of 1. The more different is the sample structure, the larger is the weight of the cases under-represented with respect to the reference universe and the lower is the cases that are over-represented. The case where weights are all equal to 1 is not necessarily the best case. If one universe segments is very small, its sample size in a perfectly proportional sample might be drastically low (e.g. 1 or 2 cases). In such a situation, drawing conclusions from 1 or 2 cases is not reasonable. It is therefore more

reliable to oversample the small segment in order to collect more responses for it and to allow for more robust analyses. When aggregation of the results at the population level is needed, the weights ensure that these cases count for their actual share in the universe.
In this particular survey a methodological decision was taken to set the theoretical sample asymmetrically for some variables (e.g., gender, age, level of education, occupational status), and one specific segment (frequent car users) was oversampled. These variables were thus clearly distanced from the data for the reference universe which, conversely, was based on a known universe that was different in its nature (i.e. frequent, the population as a whole, rather than the car-driving population). So, even in case the theoretical sample was fully respected weighting would be needed. Since there is sometimes a discrepancy between the actual sample and the theoretical sample, the weighting is needed also to re-balance the sample for this discrepancy.
The weighting procedure considered all the stratification variables: gender and age, geographical area, size of city or town, education level, occupational status.
As far as occupational status is concerned, it was preferred to opt for the employment rate rather than the percentage of people in work (which was used to construct the theoretical sample) because the initial variable tended to underestimate the active population (for the number of people in work, Eurostat includes those aged 15 and over, whilst in our case the occupational level is calculated on a more restricted segment (those aged 15-64)).
As far as the combination of gender and age is concerned, preliminary verification of the actual sample showed that only 30 interviews out of a total of 3,723 are of individuals aged 74 years or more. For the weighting it was therefore decided to use only the population aged between 18 and 74 instead of the people in age. The decision to restrict the age ranges was based on the need not to give excessive weight to a subsample that was not strongly represented.
As far as the level of education is concerned, during weighting this value was re-proportioned, adjusting it to the over-18s beginning from the official Eurostat figure used to set the theoretical sample. The Eurostat data is in fact calculated taking account of the population aged between 15 and 64, which tended to underestimate the value of graduated. These subjects were already oversampled when the theoretical sample was being constructed, but because the data had to be taken back to the official proportions, a methodological decision was taken to proportionally increase the data for graduates referred to the years not included in the reference population (i.e., the Eurostat data for graduates was increased by 7.5% for all the countries considered).
In practical terms the weighting was applied to the raw data of the actual sample as follows.
First weighting the national representative sample and the interviews carried out during the pilot, based on the data for the reference universe. The national representative sample

and the interviews carried out during the pilot were weighted together, for the variables described above, i.e.:

- Genderage
- Geographical area
- City size
- Level of education
- Employment rate

Second, based on the weighted data, the percentages derived from the frequent car users, i.e. those who on the basis of their responses to question S3bis[6] are obtained.
Once the percentage of frequent car users had been determined, derived from the national representative sample and the pilot interviews, the total sample (consisting of: national representative sample, pilot interviews and oversampling of frequent car users) was weighted together for the demographic variables of the universe and for the natural percentage of heavy car users.

2.5.2 Expanding the survey results to population

As aforesaid careful consideration was first given to determining the most suitable reference universe for combining the scientific purposes of the survey with its practical feasibility, also bearing in mind the information sources that were available and accessible. The primary target audience of the survey is car drivers who are essential for gathering information about car driving habits. However there is no uniformly accessible data on car drivers, moreover, the accessible data in the six Member States is collected using different methodologies, which make it incomparable. So for identifying the reference universe (to be used for the sampling plan and then for the weighting) it was decided to take a wider universe (the population aged 18 years or more). In relation to the information sources available, this is considered the best approximation with respect to the ideal sub-target of the survey as for many of the countries considered the car-driving population and population in age can be assumed to be very similar.
For expanding the results of the survey to population, the same assumption about the reference universe applies. The expansion is required as far as the estimation of the charging load is concerned, because the energy consumption depends on the total number of individuals using a car in a given time. The full description of the load profiles can be found in the subsequent report which is a part of the overall study (Pasaoglu et al, 2012).

[6] One of the screening question asked in the questionnaire, given in the Annexes. The related screening question is as following: “do you drive a car on a regular basis?) were classified as follows: 1) Yes, every day; 2) Yes, nearly every day”.

The weighted sample has the same composition of the (known) universe. Under the assumption that the composition of the known universe (people in age) is the same as the actual universe (people driving a car), the expansion to the latter universe consists in applying the ratio between the total size of the (known) universe and the size of the sample.
The ratios for each country are reported in Table 2-20.

Table 2-20 The ratios for expanding the results to the universe

Country	population >18-74 y,o	Expanding ratio
France	**43,641,295**	72,735
Germany	**60,863,953**	101,440
Italy	**44,249,512**	73,749
Poland	**28,587,614**	47,646
Spain	**33,859,590**	56,433
United Kingdom	**44,381,599**	73,969

2.6 Quality checks on raw survey results

After the data collection phase, we conducted quality checks on the resulting database. The initial quality checks on the database were focused on two main elements, namely coding inconsistencies and trip chain inconsistencies.

2.6.1 Coding inconsistencies

Interviewees can make mistakes when they select options in the on-line questionnaire. In several cases, mistakes can be detected by comparing correlate responses such as e.g. trip purpose and trip destination. In these cases, the inaccurate responses can be corrected. This quality check is quite time consuming because it is hard to define automatic procedures which can be applied to identify any possible mistake. Typical coding mistakes identified in this study are:

- Destination is home but trip purpose is not “return to home”
- Trip purpose is “return to home” but the destination is “relatives/friends home”
- Destination is not home, but trip purpose is “return to home”
- Trip purpose is “commuting” but origin place is “work place/school” (i.e. the same as destination place)

These mistakes can have various reasons. Most of them are probably just a matter of distraction. In some cases it seems that some interpretations of the circumstances played a role. For instance, there are individuals who apparently return every evening to their

friends/relative home rather than to their own home. So they reported "friends/relative home" as destination but also coded as trip purpose "return home" as they felt this is what they did. In these cases it seems reasonable to assume that the trip purpose captures the spirit of the trip and that the destination is basically "home" even if strictly speaking it is not.

All the coding inconsistencies detected have been corrected. In Table 2-21, the share of corrected records in each country is reported. This share ranges from 9% (in Germany and Italy) to 13% (in France, Poland and Spain). It should be noted that largely most of the corrections concern the automatic adjustment of obvious coding mistakes regarding the trip purpose when destination of the trip is "home". Other corrections concern just a small share of records (never larger than 3%).

Table 2-21 Share of corrected records during quality checks

Country	Total records	Total corrections		Corrections of trip purpose for consistency with destination "home"	
		Records	**Share**	**Records**	**Share**
France	9,008	1,164	13%	998	11%
Germany	7,347	672	9%	579	8%
Italy	7,965	725	9%	590	7%
Poland	7,287	977	13%	790	11%
Spain	6,888	866	13%	722	10%
UK	8,619	871	11%	844	10%

2.6.2 Trip chain inconsistencies

Since the questionnaire was a travel diary collecting details on departure and arrival places and times, it is expected that at least within each day individuals report a consistent trip chain, where the starting place of one trip is the destination place of the previous trip and the starting time of one trip is later than the arrival time of the previous trip. When these conditions do not apply the responses are not consistent and cannot be considered a reliable description of individual's driving behaviour.

In the database several cases of inconsistent trip chains have been detected. Among these, a typical inconsistency is the lack of a return trip to home at the end of the day (which is expected whenever the first trip of the day after is registered as starting from home). The reasons for not reporting the return trips are hardly recognisable. Looking at the data, the

return trip is missing especially for the last day of the diary. It is fair to assume that respondents who filled in the questionnaire the day after the trips skipped to connect to the questionnaire when the week expired.
There is however one possible explanation which is worth to mention that seems applicable to some not coded trips. Since the diary concerned the mobility of individuals driving a car, the respondents were instructed to report the details of the trips they made by car as driver. In some cases apparently missing trips might be trips made as passenger. For instance, in the case of a leisure trip made together with some friends with one car, the driver can change between the onward and the return trip. In this case, the respondent reported only the portion travelled as driver (e.g. the onward trip) which is correct according to the instructions received. The reason for limiting the questionnaire to car trips made as driver was to exclude individuals usually travelling by car only as passengers. These individuals were actually not relevant for the survey. However, this way the special case described above could not be detected. Nevertheless, the analysis of inconsistencies has shown that missing trips are due in large part to some individuals who have more or less systematically omitted some trips. Therefore, the share of incomplete chains due to the trips made as passengers does not seem very relevant.
When a mode chain for a given day is clearly inconsistent or incomplete, that day is not suitable for the analysis and has to be dropped; otherwise the resulting driving profiles would be biased.

2.6.3 Cleaned sample for the analysis of driving profiles

After the quality checks described above, some records have been dropped from the sample as far as the analysis of the driving profiles is concerned (instead the sample is not modified for the analysis of the attitude towards electric cars). As mentioned, these records are not evenly distributed in the sample, i.e. inconsistencies are largely the results of some individuals who systematically missed to provide correct trip chains. As result dropping records has meant also dropping some individuals. Table 2-22 Share of individuals retained in the sample for the analysis of driving profiles after quality checksreports the size of the revised sample in comparison to the original sample. In all countries nearly 10% of individuals have been eliminated because all their responses do not satisfy a consistency criterion.
Instead, Table 2-22 shows the share of valid trips by country and day of the week. Given that nearly 10% of individuals have been completely excluded and also single days of other individuals have also been dropped from the sample, one may expect that the number of remaining valid records (trips) is significantly below 90%. Instead the share of valid trips amounts to 89% in three countries and 88% in one country. The worst value is anyway 82% (Italy). The reason is that the individuals fully eliminated not only reported

incomplete chains, but also reported few trips, so their relevance on the whole trips sample is minor.

Table 2-22 Share of individuals retained in the sample for the analysis of driving profiles after quality checks

Country	Original sample	Revised sample	Ratio
France	623	581	93%
Germany	606	560	92%
Italy	613	542	88%
Poland	548	507	93%
Spain	617	564	91%
UK	716	627	88%

Table 2-23 Share of trips retained in the sample for the analysis of driving profiles after quality checks

Country	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Total
France	86%	90%	92%	92%	88%	84%	85%	88%
Germany	88%	90%	92%	92%	87%	89%	86%	89%
Italy	81%	83%	86%	85%	82%	77%	79%	82%
Poland	87%	88%	89%	91%	92%	88%	84%	89%
Spain	82%	87%	91%	88%	84%	82%	84%	85%
UK	85%	88%	92%	92%	93%	83%	87%	89%

3 Comparisons with National Travel Surveys data

Elementary data collected by national travel surveys (NTS) is available for two countries: UK and Germany, Department for Transport (2012), MID (2008) respectively. In these two countries travel diaries on a weekly basis provide details on car usage which are similar (although not exactly identical) to those deriving from the sample survey carried out for this study[7]. Comparing the outcome of the sample survey to the information extracted from the NTS is therefore a useful validation exercise.

It should be clear that the survey administered in the context of this study was much simpler than the NTSs. The latter are big, well established surveys with a large budget and a long history. Their sample is incomparably larger, the content of the questionnaire and its administration can benefit from this availability of resources as well as of a long record of experience. Therefore it cannot be expected that the survey results match exactly those of the NTS.

Given the difference in size and complexity of the two surveys, the comparability of the results is satisfying. Starting from the UK, the most immediate comparison is between the average daily number of car trips[8] resulting from our survey carried out in UK and the same indicator extracted from the UK NTS database. As shown in Figure 3.1, this number is slightly lower for the sample survey of this study (around to 2.5 trips per day) than for the UK NTS (around 3 trips per day).

[7] Germany NTS includes only one travel day for the individuals, whereas UK NTS incorporates 1 week of travel data of the individuals.

[8] The comparisons below make reference only to car trips made as driver

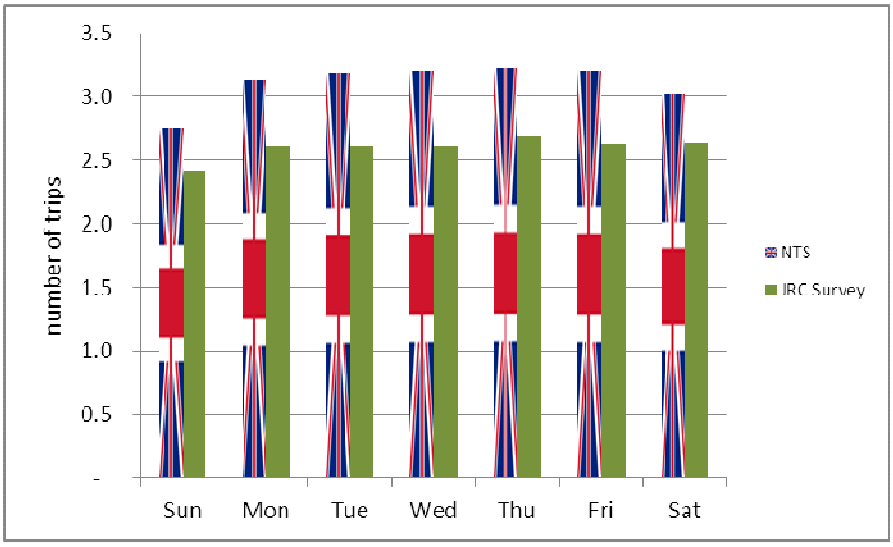


Figure 3.1 Comparison of number of car trips per day between the survey and the UK NTS. Source: Derived from collected data and UK NTS 2008 data

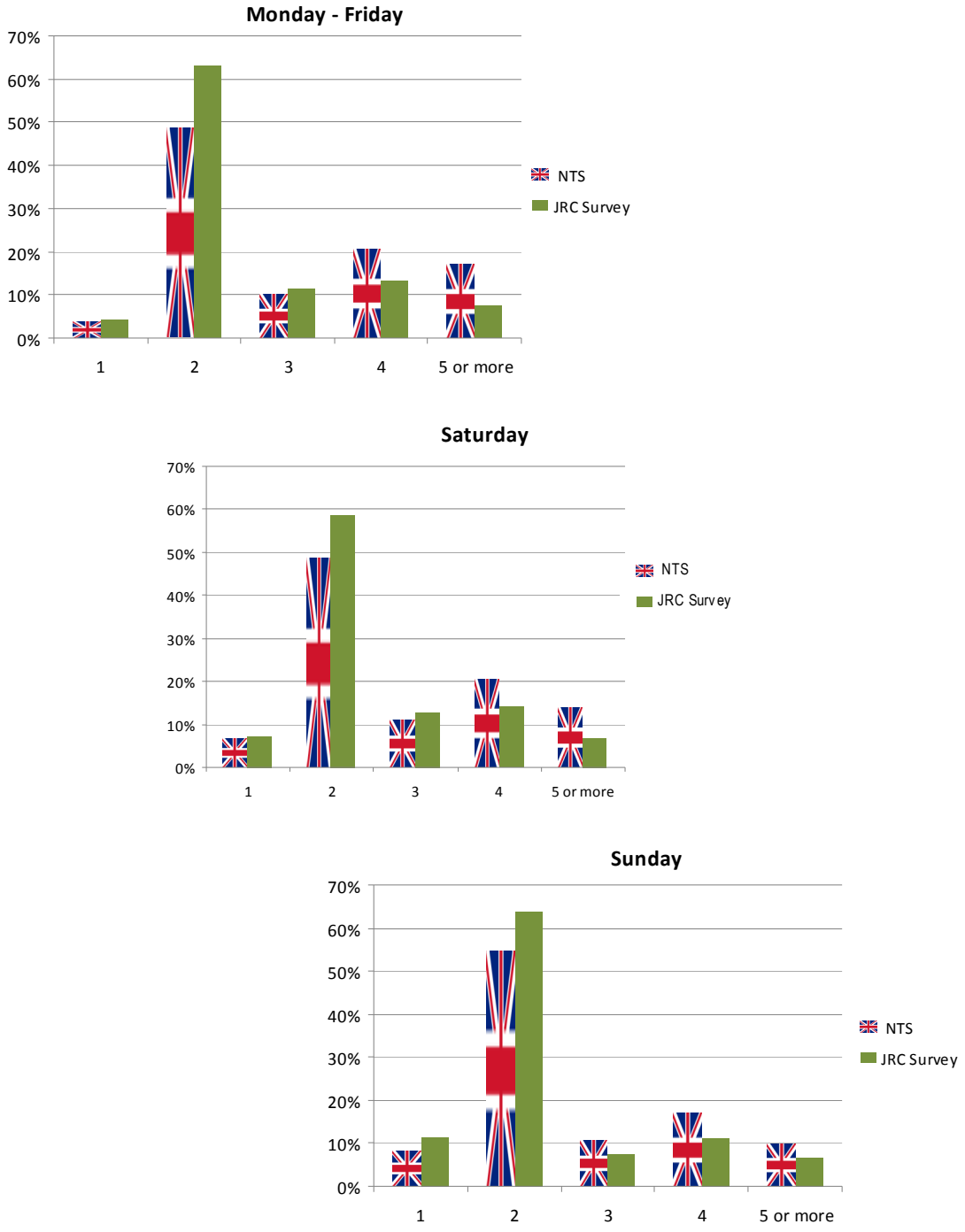


Figure 3.2 Comparison of distribution of individuals by number of car trips per day between the survey and the UK NTS. Source: Derived from collected data and UK NTS 2008 data

One possible reason for this discrepancy could be found in a different definition of trip. In the survey for this study, individuals compiling the diary were instructed to consider a single trip any car journey made without intermediate stops or of intermediate stops with duration lower than 10 minutes. This means, for instance, that a trip made from home to accompany a child to school then returning to home without stopping for more than 10 minutes is considered as one trip only. Instead, in the case of UK NTS "Interviewers were instructed to divide a round trip into 2 trips, outward and homeward. Travel involving a continuous series of calls made for the same purpose (by a doctor, for example) was treated as a round trip" (Department for Transport, 2009)[9].

This different definition can partially explain the lower average number of daily car trips (as driver) registered in the survey for this study. The comparison of the distribution of individuals by number of daily trips shows that the share of single and double trips is larger in the sample survey than in the UK NTS. This difference is compatible with the explanation based on the definition of trip. However there is no way to decide whether the lower share of individuals making more than two trips per day is just a matter of trip definition or it hides also some missing trips. Truth might be in between.

Looking at the structure of the car mobility rather than to its size, the results of the survey seem well comparable to those of the UK NTS. Figure 3.3 shows the comparison in terms of distribution of car trips per departure time. The two distributions are very similar. At least from this point of view, even if some car trip was not captured by the sample survey, the description of the daily mobility is not biased. The same conclusion can be taken looking at the average trip distance (Figure 3.4) and the average trip driving time (Figure 3.5). Indeed, for both these elements, the outcome of the sample survey is very similar to the data extracted from the UK NTS database Figure 3.5

The differences are much larger when the distribution of parking places is considered (Figure 3.6.). Despite the comparability between the two sources can seem poor at a first sight, there are however some qualifications to consider. The definition of parking places in the questionnaire of the UK NTS is different (somewhat less detailed) than in the questionnaire of the sample survey. Consequently, the comparability of the two results is more problematic than for the other elements mentioned above. Indeed, some of the alternative parking places is not necessarily clearly different to each other. For instance, if reserved parking place close to the work place are placed on the kerbside, one might be in doubt between reporting "private parking at work" and "kerbside regulated". The same applies to parking at home: who parks on the street might nevertheless report parking "on own premises".

[9] page 58

It should also be noted that in the UK NTS own and friends premises are classified together, while in the sample survey questionnaire, own place at home was a different category, while there was not a specific item for parking close to friends' home. Therefore in many cases the respondents of the sample survey will have chosen "on kerbside" for trips made on visiting purposes, whereas in the case of the UK NTS, the parking for the same trips would be registered under "own or friends premises". Indeed, in the sample survey parking on street is overrepresented and own/friends premises is underrepresented.
All in all, parking places are difficult to compare and so even the large differences registered in comparison to the UK NTS results do not question the validity of the sample survey.

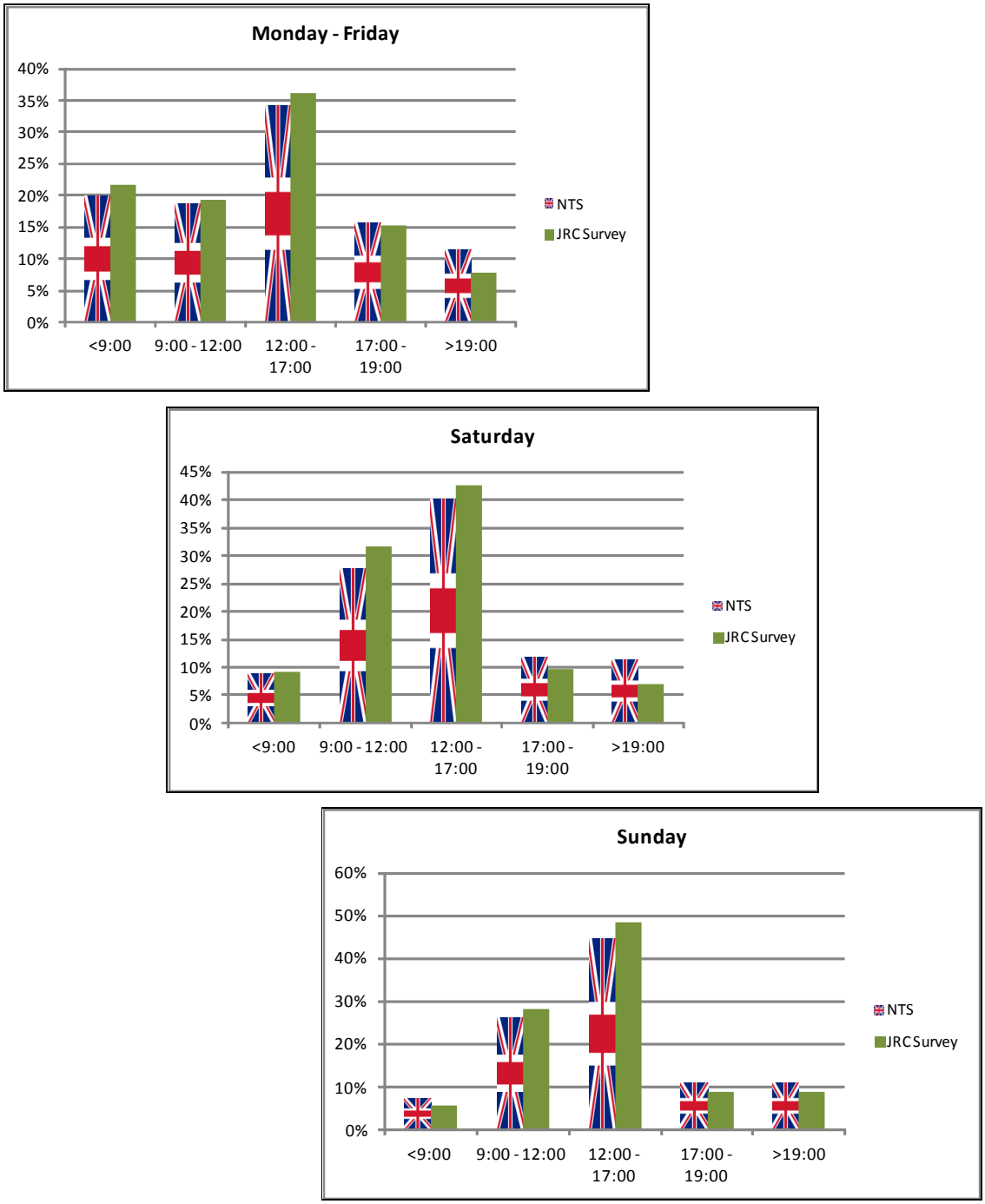


Figure 3.3 Comparison of distribution of car trips by departure time between the survey and the UK NTS.
Source: Derived from the collected data and UK NTS 2008 data

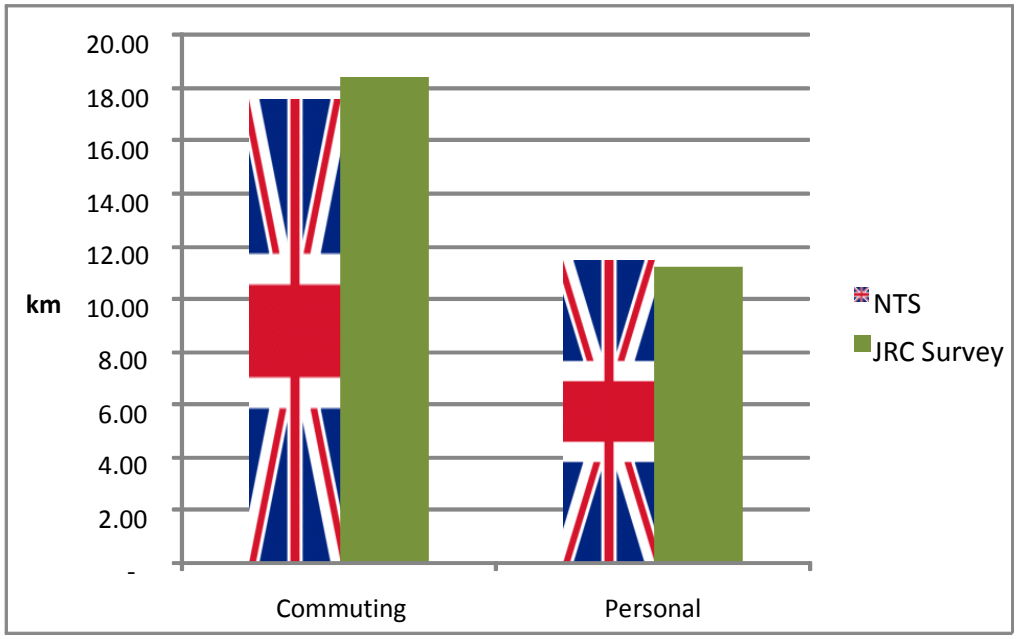


Figure 3.4 Comparison of average car trip distance between the survey and the UK NTS – Monday to Friday.
Source: Derived from the collected data and UK NTS 2008 data

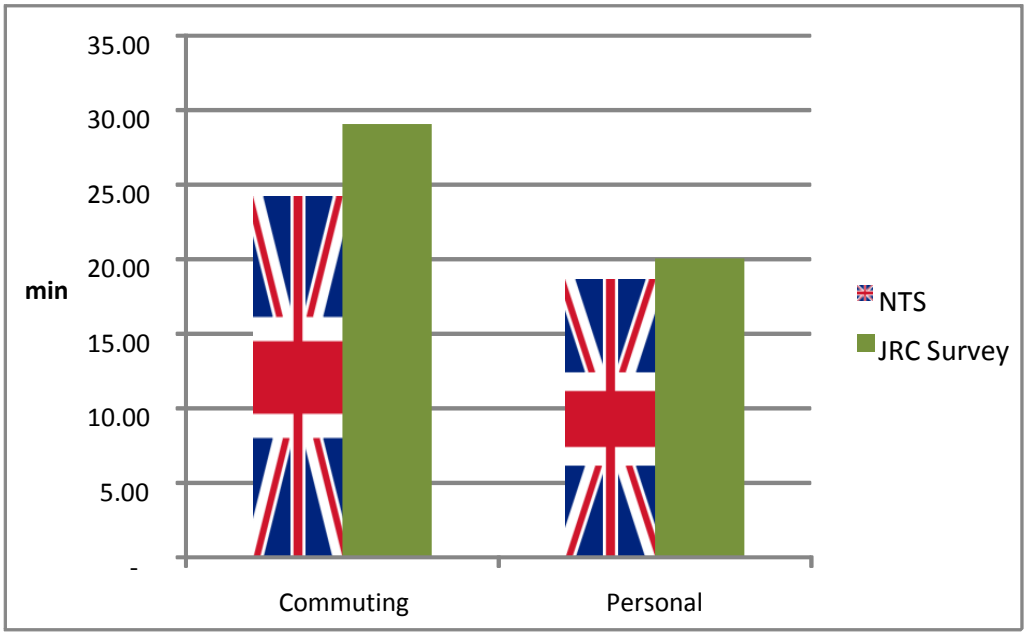


Figure 3.5 Comparison of average car trip duration between the survey and the UK NTS – Monday to Friday

Source: Derived from the collected data and UK NTS 2008 data

Figure 3.6 Comparison of distribution of car trips by parking place between the survey and the UK NTS – Monday to Friday Source: Derived from the collected data and UK NTS 2008 data

Moving to Germany, the comparison concerning the average number of car trips (as driver) per day results in the same difference noted for the UK: the data registered by the sample survey in Germany is below the data extracted from the database of the German NTS 2008 (Figure 3.7). The difference is correlated to a lower number of individuals taking more than 2 trips per day (Figure 3.8). On the other hand, it is difficult to assess whether this difference can be attached to a different definition of "trip" used in the two surveys, or the sample survey for this study failed to capture the whole car mobility.

However, looking at the structure of the car mobility, the comparability of the two surveys is good. The distribution by departure time (Figure 3.9), the average trip length (Figure 3.10) and the average trip duration (Figure 3.11) compare well between the two surveys. The only exception is the average trip length of Sunday trips, which is significantly higher in the sample survey than in the German NTS data. This discrepancy can be related to the different sample size. The smaller sample of the survey for this study is more sensitive to long trips. It should also be considered that on Sunday less car trips are made than in other days, so the impact of even a relatively small share of long trips (which are most likely to occur in non-working days) is even larger than in an average day.

The German NTS survey does not report details on the parking places, so comparisons are not possible in this respect.

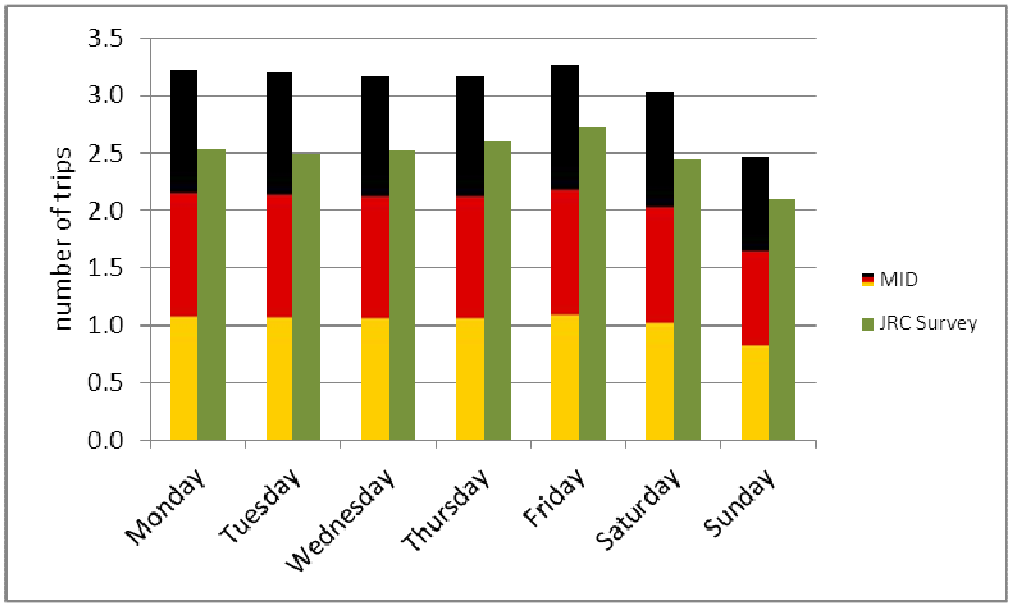


Figure 3.7 Comparison of number of car trips per day between the survey and the German MID

Source: Derived from the collected data and MID 2008 data

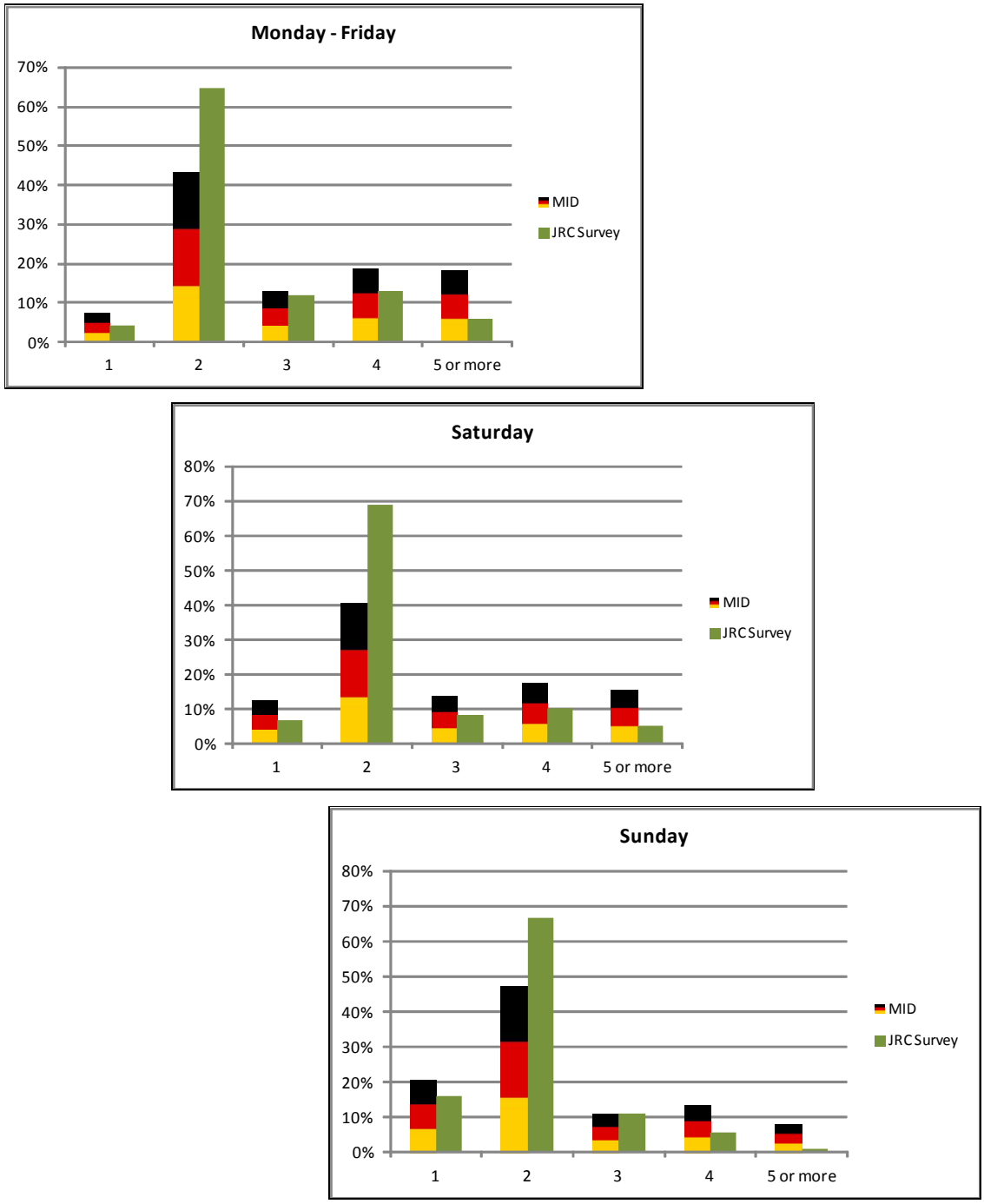


Figure 3.8 Comparison of distribution of individuals by number of car trips per day between the survey and German MID. Source: Derived from the collected data and MID 2008 data

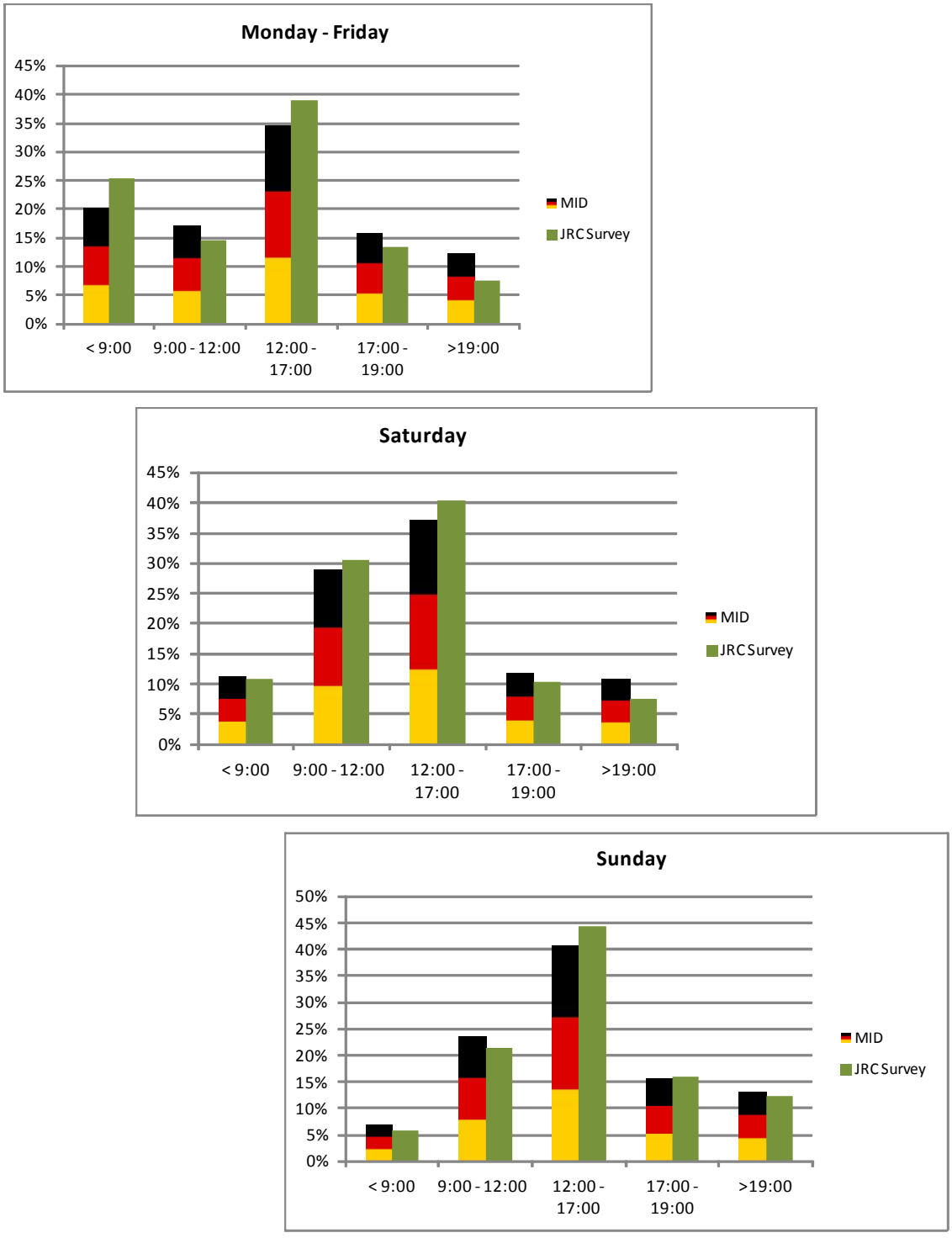


Figure 3.9 Comparison of distribution of car trips by departure time between the survey and German MID

Source: Derived from the collected data and MID 2008 data

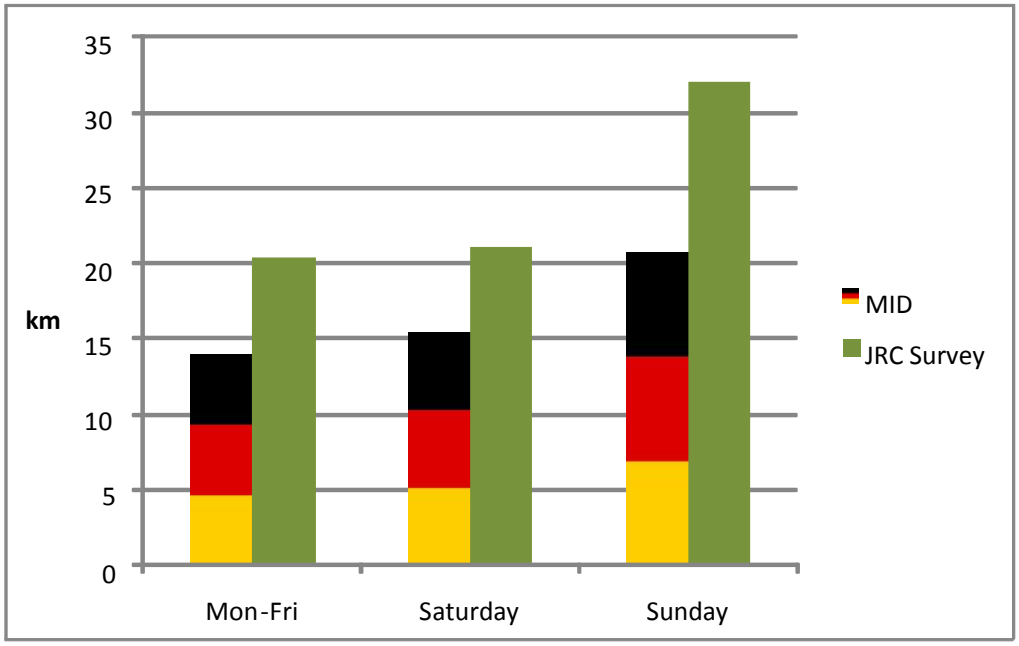


Figure 3.10 Comparison of average car trip distance between the survey and the German MID. Source: Derived from the collected data and MID 2008 data

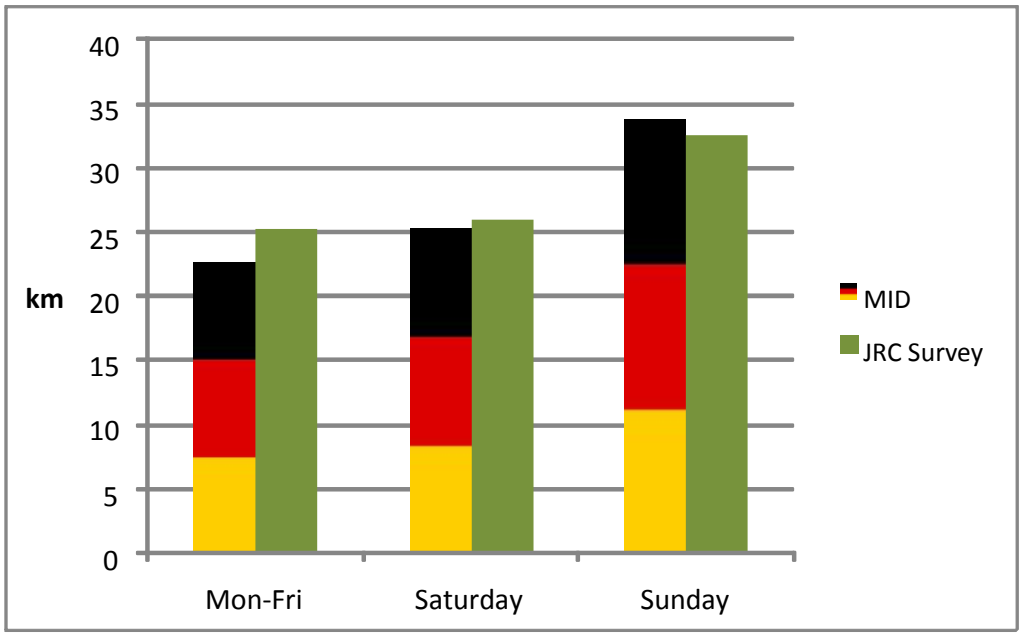


Figure 3.11 Comparison of average car trip duration between the survey and the German MID. Source: Derived from the collected data and MID 2008 data

4 The analysis of driving behaviour

The comparisons provided in the previous chapter support the conclusion that the data collected with the sample survey provides a reasonable picture of car mobility in the six countries investigated. The amount of information that can be drawn from the databases created within this study is huge. In the following some general descriptive statistics are presented in order to provide an overview of the car usage in each country. Similarities and differences are discussed.

It should be noted that all the statistics presented below are computed on the weighted results.

In Figure 4.1 the average number of daily car trips (as driver) in the different days of the week is shown for the six surveyed countries. The average is slightly different across countries and, within each country, across the different days of the week. The largest average is registered in France (2.9 trips per day) while the lowest average value is in Spain (2.4). These two values are statistically different at 95% level of probability[10] whereas the differences between the other countries are not (but the average for Italy – 2.7 trips per day – is also statistically different from the Spanish average).

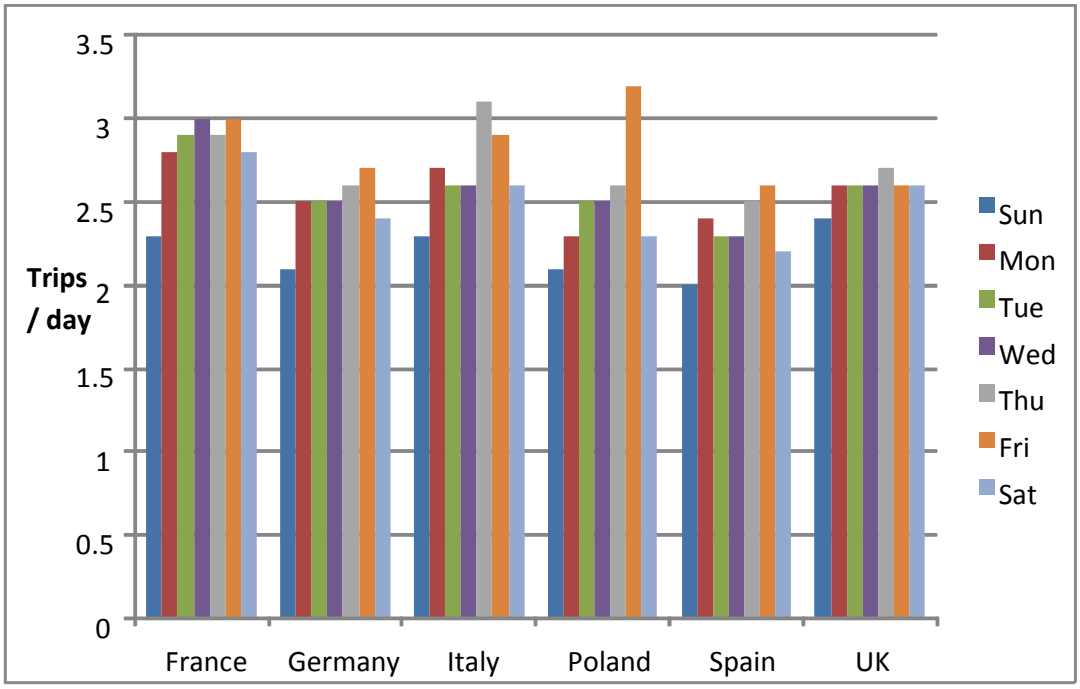


Figure 4.1 Average number of car trips per day by country

[10] In the following, wherever the statistical significance is discussed it is always meant at a 95% level of probability unless diversely specified.

In all countries the number of trips made on Sunday is lower than on the other days. A statistical test reveals that this difference is significant in all countries but UK. In most of the countries the average is higher on Thursday and Friday (in France the maximum is on Wednesday and Friday) but in most of the cases the differences are not statistically significant: only the much larger average registered in Poland on Friday and in Italy on Thursday are.
Also remembering the relatively limited size of the sample and the consideration that some trips might be missing (as revealed by the comparison of UK and German results with the national surveys, see section 3 above), it seems reasonable to conclude that while the reduced use of cars on Sunday is a robust results, the other differences across the days of the week and across countries should be taken with care. The results suggest that countries with a lower motorisation rate – Poland and Spain – probably make slightly less car trips than countries where motorisation is larger – Italy, France, UK – and that in the end of the working week slightly more trips are made, but the evidence is not that strong.
As mentioned in section 2, given the difficulties to recruit the respondents, the Poland sample includes also some incomplete questionnaires. This circumstance seems of limited effect on the results. The average number of daily trips computed only on the complete questionnaires is 2.497 instead of 2.533 resulting from the whole sample. This difference is not statistically significant. Other tests have been made for average daily driven distance and average daily driven time and again differences are very small and not statistically significant.

Looking at the purposes of trips and at their distribution by day, the countries look very similar to each other (Table 4-1). First of all, return trips to home are a bit less than 50% as effect of a certain share of non-home-based trips, Yet, since in the survey trips with origin and destination at home (i.e. presumably those with intermediate stops lasting less than 10 minutes) have been classified as return trips, a country like Spain, where the share of individuals reporting one (short) trip per day only is considerable (see section 5 below) can show a 50% share of return trips. Return trips are generally a higher share of daily mobility on Saturday and Sunday. This suggests that non-home based trips are more frequently made after work, before to return home. Differences however are hardly significant in statistical terms.
During working days business related trips and personal related trips are more or less in the same proportion, each explaining nearly one fifth of the overall weekly mobility. In all countries nearly 80% of the week mobility occurs between Monday and Friday (i.e. in five days out of seven: slightly more than the 70% of total time). This is especially due to the lower mobility on Sunday, when business trips are virtually absent (and also on Saturday they account only for 1% of total weekly and far less than 10% of Saturday car trips.

The comparison is made using these only two large categories of purposes for two reasons. On the one hand, going into more details would result in analysing sometimes small shares. Even aggregating all of the personal purposes under the same category, the share of these trips on Sunday is hardly as large as 5% of total weekly trips. A separation between e.g. visiting friend and leisure within this small share is not very informative. On the other hand, looking into the elementary data casts some doubts on the accuracy of the purpose registered by the respondents. For instance, regular daily trips to the work place have been registered as "commuting", as expected, but also as "working business". Trips with destination to a shop have been registered as "shopping", as expected, but also as "personal business". It is fair to assume that the difference between working and non-working trips have been correctly reported, while the correctness of specific purposes within these two categories is more questionable.

Table 4-1 Car trips distribution by day and purpose

	Business[1]	Personal[2]	Return	Total
France				
Mon-Fri	22%	20%	37%	79%
Saturday	1%	6%	6%	13%
Sunday	0%	4%	4%	8%
Total	***23%***	***31%***	***46%***	***100%***
Germany				
Mon-Fri	22%	22%	37%	81%
Saturday	1%	6%	6%	12%
Sunday	0%	3%	4%	7%
Total	***23%***	***31%***	***46%***	***100%***
Italy				
Mon-Fri	23%	21%	35%	79%
Saturday	1%	6%	6%	13%
Sunday	0%	4%	4%	9%
Total	***24%***	***31%***	***45%***	***100%***
Poland				
Mon-Fri	19%	23%	35%	78%
Saturday	1%	6%	6%	12%
Sunday	0%	4%	5%	10%
Total	***21%***	***33%***	***46%***	***100%***
Spain				
Mon-Fri	21%	19%	39%	78%
Saturday	1%	6%	6%	13%
Sunday	0%	4%	5%	9%
Total	***22%***	***28%***	***50%***	***100%***
UK				
Mon-Fri	20%	23%	34%	77%
Saturday	1%	6%	6%	13%
Sunday	0%	5%	5%	10%
Total	***21%***	***34%***	***45%***	***100%***

1: includes commuting to work/school and work-related business

2: includes personal business, shopping, leisure, visit friends and relatives, accompanying someone and other

The distribution of trips by time of the day is not exactly the same across countries although a common pattern can be identified (Figure 4.2). During working days, nearly 20% of the trips are made before 9.00 in the morning. Another 20% of trips is made until noon and another 20% is made after 17.00 in the afternoon. The remaining 40% of car trips occur between noon and 17.00. On Saturday the share of trips made before 9.00 in the morning is basically halved and on Sunday it is further reduced. On Saturday more trips than on working days are made especially between 9.00 and 12.00 in the morning, while the car mobility after 17.00 in the afternoon is not that bigger. Instead, on Sunday especially trips between 17.00 and 19.00 in the afternoon are much more frequent than in the working days.

This common pattern is not surprising: in the week-end only few working trips occur and people tend to start activities later. Some leave on Saturday morning for leisure trips and return on Sunday late afternoon. The differences between countries do not disconfirm this pattern, but show some specificity.

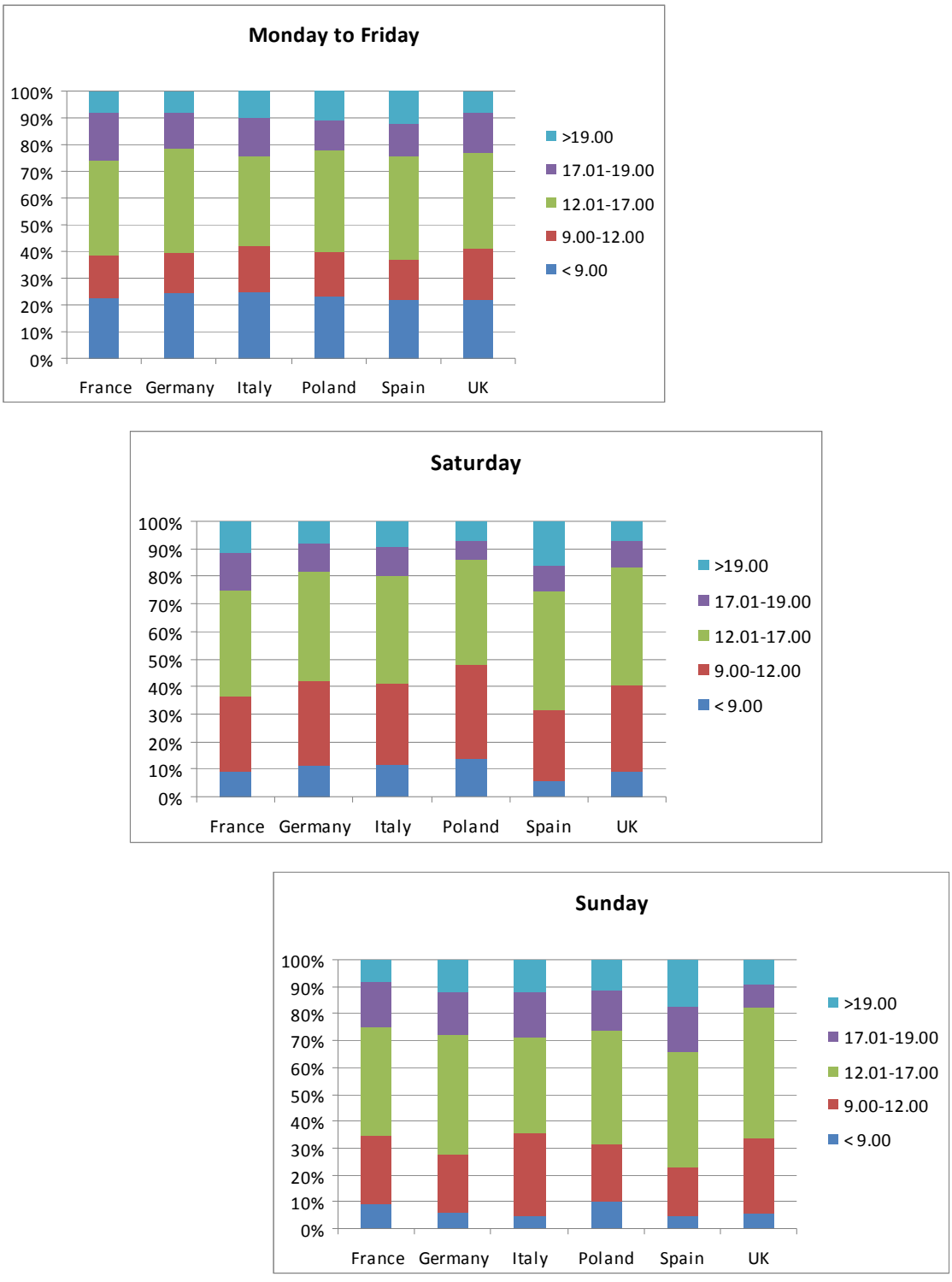


Figure 4.2 Car trips distribution by time of the day (including return home)

The most clearly recognisable is that the share of trips after 19.00 in the afternoon is clearly higher in Spain, especially in the week-end, than in the other countries. As Figure 4.2 shows, there are many other differences in the time distribution of trips across countries. Chi squared test reveals that these differences are significantly different even though they are not easily interpretable in a clear framework.
More clear differences appear considering the distance made during car trips. Figure 4.3 shows the average daily driven distance in the six countries. Three groups can be identified. On average the daily driven distance exceeds 70 km or even 80 km in Poland and Spain, it is around 40 km in UK, while in the other three countries it is between 50 and 60 km. The differences between these three groups are statistically different. Instead the differences between the days of the week registered in each country are not significant.

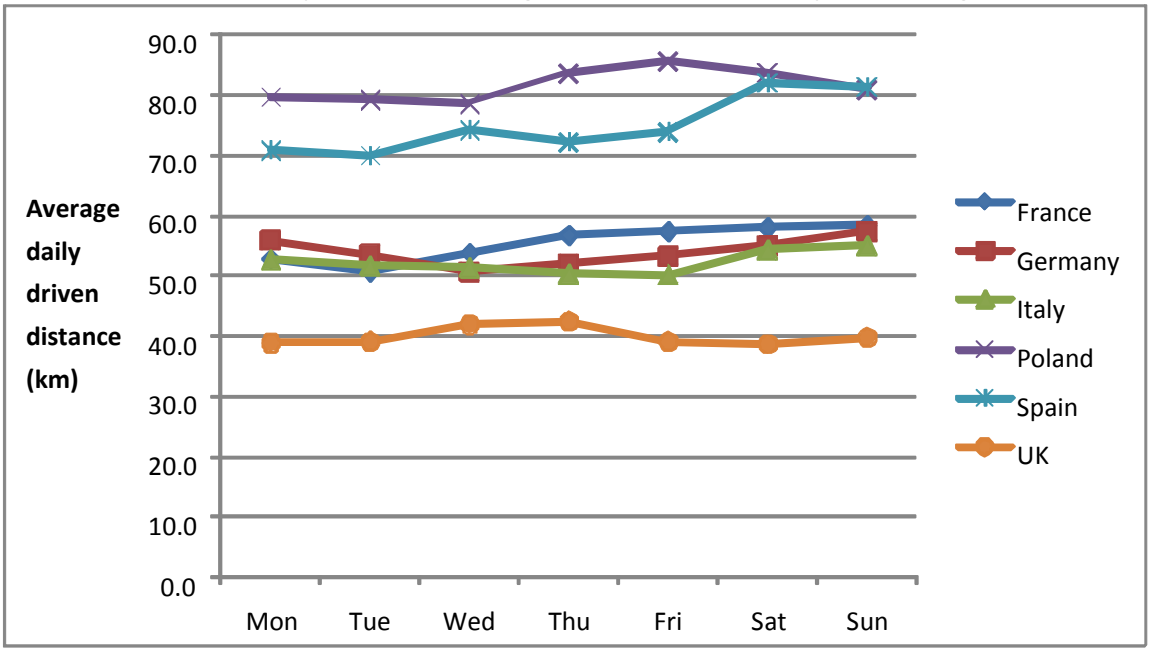
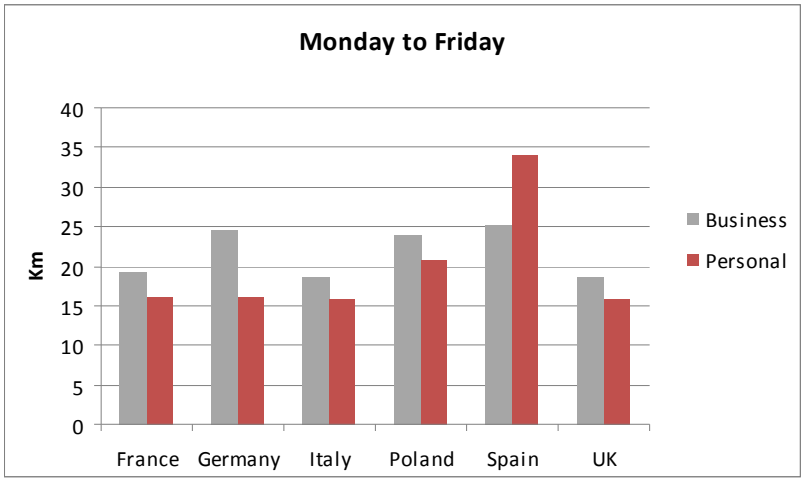
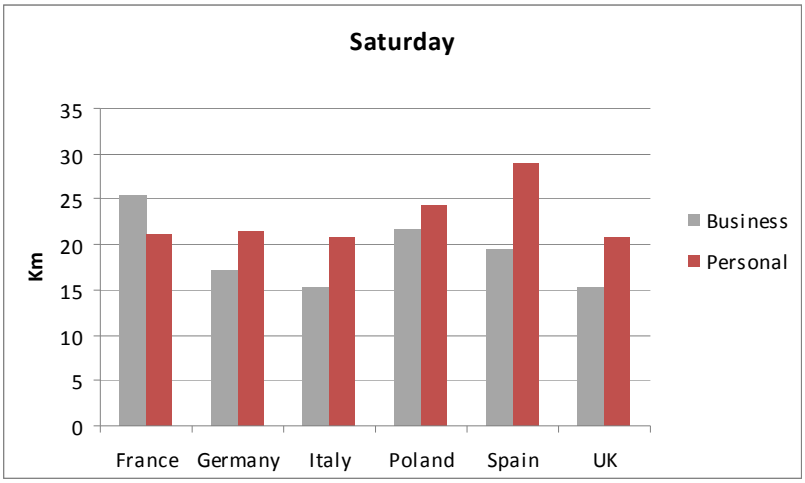


Figure 4.3 Average daily travel distance (km) by day of the week.

As aforementioned, Figure 4.1 reveals that the average number of daily car trips in Poland and Spain is slightly lower than the other countries. Since they drive longer (Figure 4.3), it can be concluded that the average length per trip for Poland and Spain is higher, which is confirmed by (Figure 4.4). While interpreting Figure 4.4, it should be kept in mind that some mobility segments are small. For instance, the high value of the average distance of business trips on Sunday in Germany looks strange at first sight, however this data refers to less than 1% of trips (Figure 4.4), so it is highly conditioned by a few observations.

Figure 4.4 reveals that in all of the countries considered in this study, except Spain, business trips are longer than personal trips from Monday to Friday and are shorter on Saturday but since the number of working-related trips in the week-end is small, this comparison is of limited interest. What appears clearly is that personal trips are longer in the week-end than in the working days as expected. The statistical significance of the differences in average trip length by purpose in working days is clear for Germany, while it is weaker for the other countries.





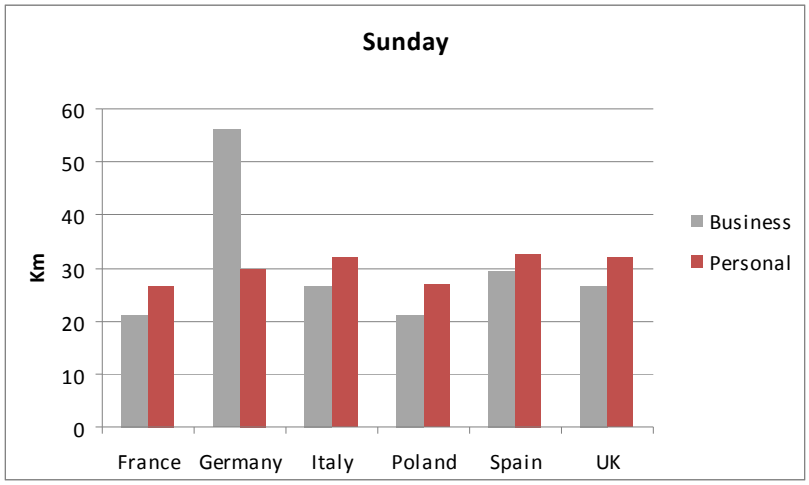


Figure 4.4 Average trip distance (km) by trip purpose.

Figure 4.5 reveals that broadly speaking average total driven time per day shows mainly three different behavioural patterns across the countries considered in this study. However, the related behavioural patterns are not exactly similar to the observed patterns for the average driven distance (Figure 4.3). Poland and Spain have the longest driving time – between 1.5 and 2 hours per day – but the difference between the two countries is significant (in statistical terms). The other countries show more limited differences, most of which are statistically not significant. This slight difference between distribution of average driving time across countries and distribution of driving distance means that the average speed is not the same. In most of the countries the average speed is close to 45 kph. It is slightly higher in Spain and significantly lower in UK (below 40 kph).

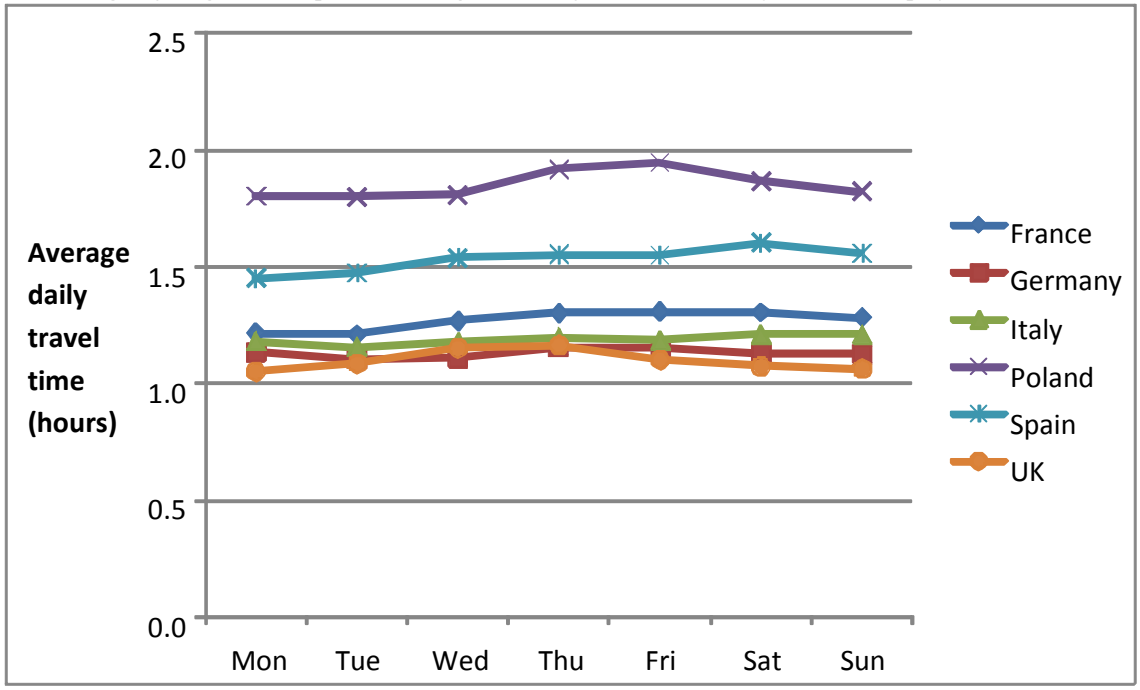


Figure 4.5 Average daily travel time (hours) by day of the week

The average duration of personal trips in working days is remarkably similar in the countries under consideration – around 20 minutes – in the four countries where the average daily driving time is also similar (Figure 4.6). Average duration of business trips is slightly more differentiated, with Germany and UK closer to 30 minutes per trip whereas France and Italy are closer to 25. This difference is statistically significant and also the difference between the average duration of business trips and personal trips is significant in all countries.

Personal trips are longer on Saturday and also their duration increases at a slightly lower rate compared to the same trips on other days of a week. Apart from Spain and Poland

aside, as shown in Figure 4.4, the average distance of personal trips increases from nearly 15 km to nearly 20 km whereas the average duration increases from 20 minutes to 25 minutes (Figure 4.6). Based on these we can conclude that trips in the week-end are slightly faster. In most of the countries a further increase of the average personal trips distance is observed between Saturday and Sunday, whereas average time needed for these trips remain more or less the same, i.e. individuals make longer but faster trips on Sunday than on Saturday.

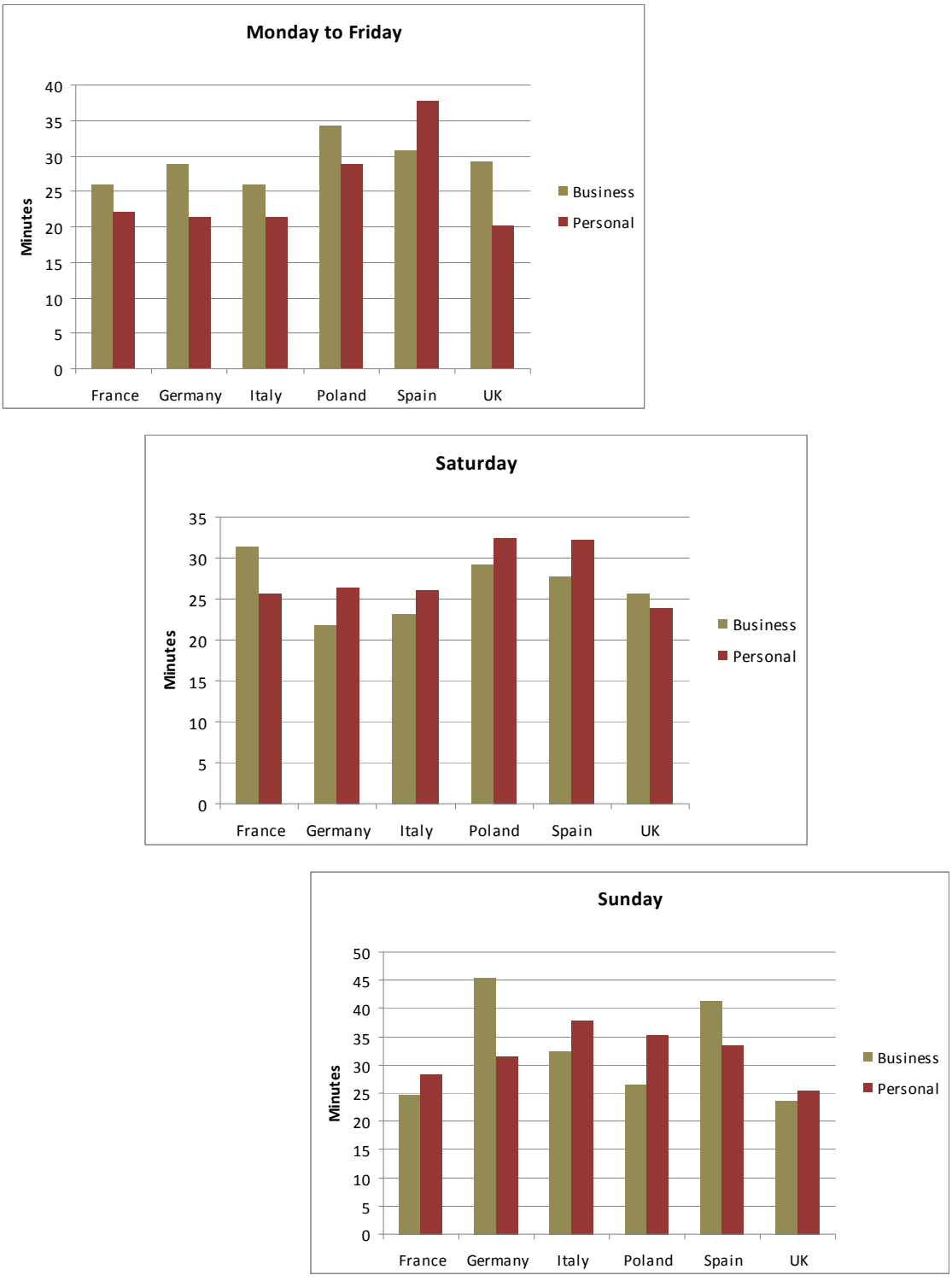


Figure 4.6 Average trip duration (min) by trip purpose.

Certainly when analysing the trips diary data the first questions are those addressed above: how many trips, why, when, how long and so on. However, especially considering the final goal of this study – the estimation of load profiles – the periods when individuals are not driving are not less important. Also because, driving activity actually explains only a very minor part of the day. It was mentioned above that the average daily driving time is between 1 and 2 hours in all countries. This means that for the largest part of the day a given car is parked[11].

Parking time can be split in two parts. One part can be named "**active parking**": it is the time when the car is parked after a trip (the terms "active" is chosen because trips are made as a precondition for making an activity: working, shopping, visiting someone else, etc.). The other part can be named, for sake of symmetry, "**inactive parking**": it is the time when the car is parked before the first trip of the day or after the last trip of the day (i.e. before the individual starts activities or after the individual ends activities).

As illustrated in Figure 4.7, active parking time is, on average, a minor part of the parking time. From Monday to Friday in all countries the average duration of active parking time is around 6 hours per day. Therefore inactive parking amounts to more than 16 hours per day. On Saturday and Sunday this time is even larger. As we mentioned above, the daily driving time is not much different in the week-end and in the working days. Therefore the longest duration of the inactive parking time is explained almost entirely by shortest active parking time. Of course, the reason for this shortest time is that in the weekend there are very few commuting trips (which are followed by several hours of parking before returning home after work).

Despite the differences between countries are often statistically significant (e.g. the active parking time in France is significantly higher than in UK) they are not so large to be considered significant also in practical terms. In other words, the observation that active parking lasts around 6 hours per day in all countries is more relevant than the small differences across countries.

As already mentioned in section 3, the results of the sample survey and the UK NTS for the detail on the parking place should be analysed by keeping in mind that different interpretations can have been made by respondents. Nevertheless Figure 4.8 below shows the distribution of parking places in the different countries in working days.

Interestingly, in all countries nearly 10% of trips are described to end parking the car in a private parking at their own home. Apart from this common result, the distribution of

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[11] In some cases cars are driven by more individuals in the same day. Therefore the average parking time is actually lower than the average time when individuals are not driving. In order to collect a precise estimation of the parking time a survey based on vehicles rather than on individuals should be made. Yet, this aspect does not change the basic fact that cars remain parked for most of the time in a day.

parking places looks different in each country. In France, the most common place to park a car seems to be a private garage or private area. Also public areas and public garages are widely used. Germany is the country where car drivers seem to have more frequently reserved park places at work: nearly 20%, twice than UK and Italy which are the countries with the highest share of car parked in unregulated kerbside places. In UK unregulated kerbside seems to be the most common parking place, while in Poland and especially in Spain regulated kerbside is much more widely reported than unregulated places on street. These results illustrate that different parking policies are followed in the countries. In Germany and France, more dedicated areas and garages are provided and parking on street is less frequent. In UK and Spain kerbside is the most common place to park even if in Spain most of places along street are regulated and in UK are not. Italy and Poland are in between, with more dedicated areas than in UK and Spain, but less than in France and Germany.

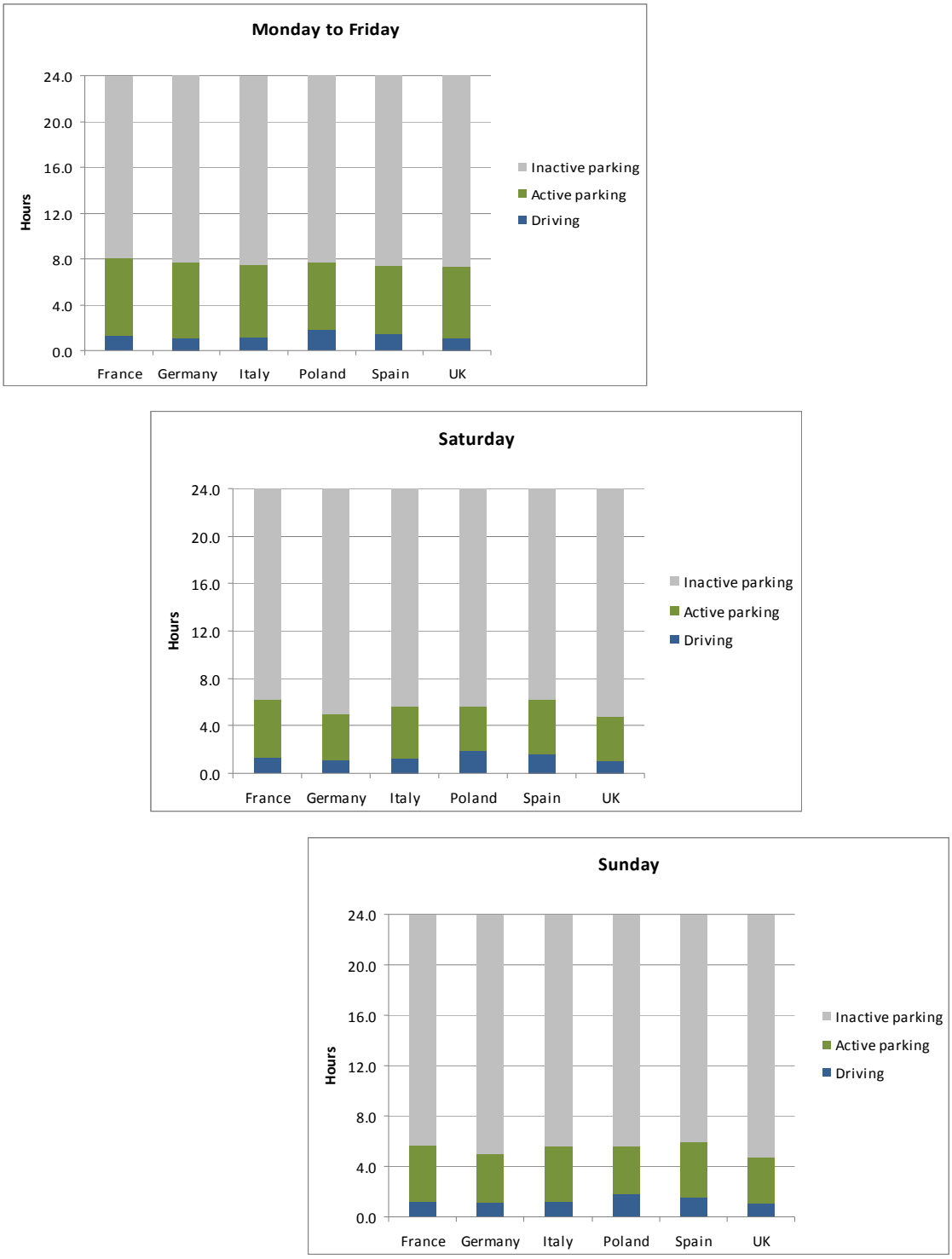


Figure 4.7 Average daily distribution of driving and parking time.

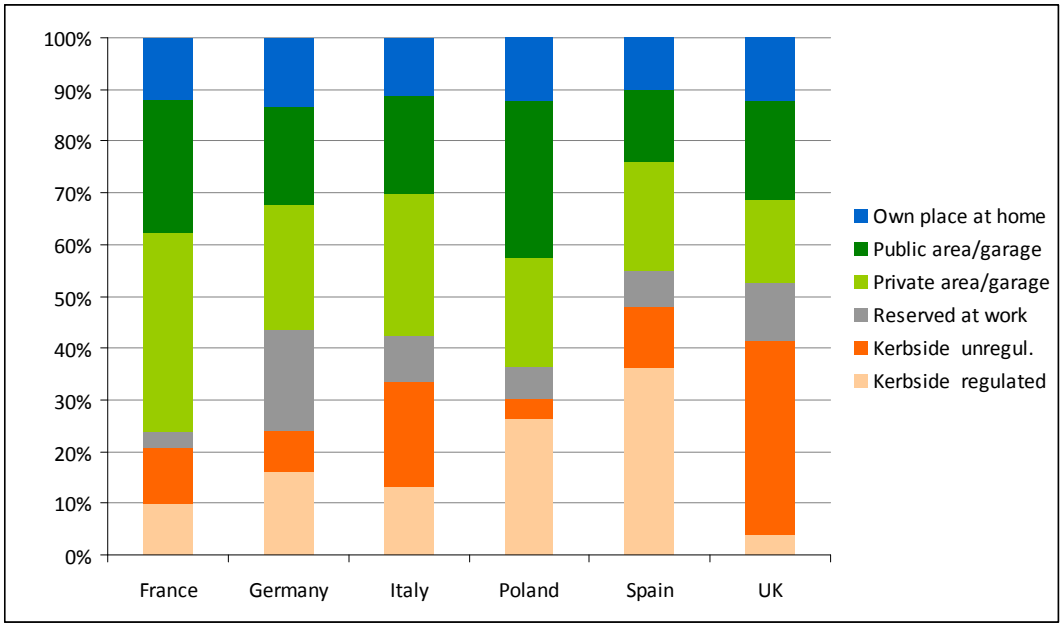


Figure 4.8 Distribution of parking places (active and inactive parking) – Monday to Friday .

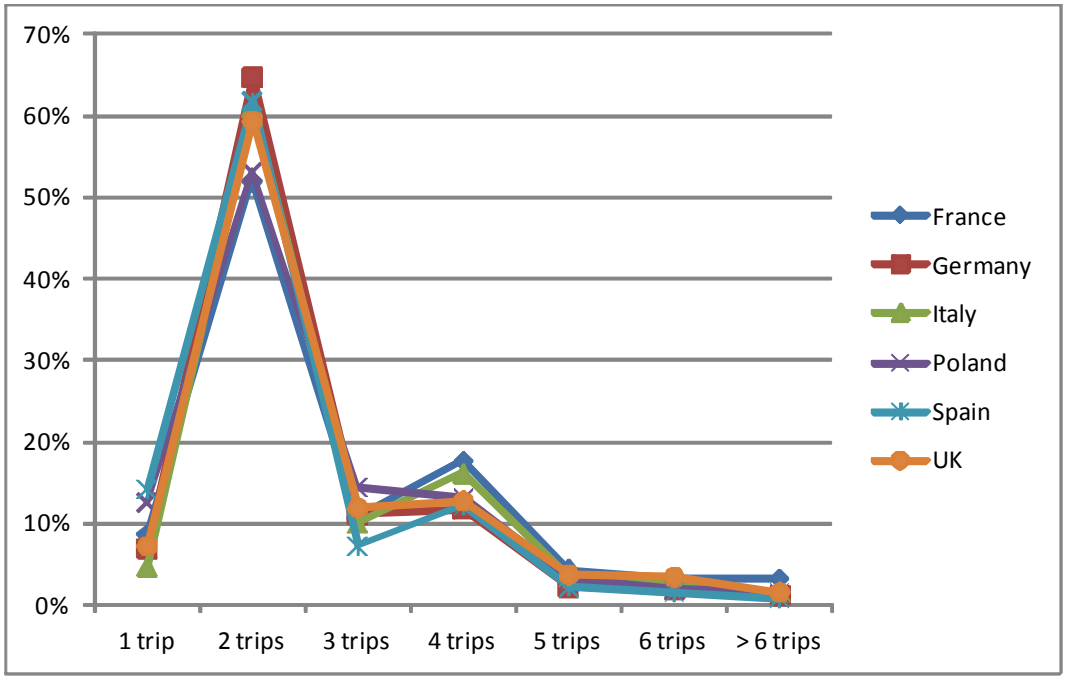


Figure 4.9 Distribution of daily car trips by country.

The average number of car trips (as driver) per day in all countries is close to 2.5. This average is the result of some individuals making less than two trips per day and other individuals making more than two trips. Figure 4.9 shows that in all countries the most common daily trip chain is made of two trips. Germany has the largest share of two-trip chains (65%) while Poland has the lowest share (53%). In five countries out of six, the second most common trip chain includes three trips; only in Spain it is more frequent that only one trip is made daily rather than three trips. Also, four trips are more common than three trips. The reason is that the large majority of trips are originating from home and are followed by a return to home.

For instance, Figure 4.10 illustrates the frequency of the various trip chains by purpose[12] in the six countries. In all countries around one third of all daily trip chains are represented by the sequence home-work-home (Poland is an exception as this chain explains one fourth of the total). Home-visit-home, home-personal business-home and home-shopping-home explain another fourth. Also, in all countries the largest share of trips are originating from home. The first trip chain where a non-home based trip is present is not the same across countries but it always represents less than 2% of total trip chains and even when different trip chains including one non originating from home trip are assembled together, like in Figure 4.10, they hardly amount to 5% of total chains. In brief, in all surveyed countries people tend to make single-purpose trips[13] and return home after each car journey.

12 In order to make the data comparable, in the figure the purposes are aggregated. Namely, for two trips chains "visit" includes visiting friends or relatives as well as leisure trips. For longer chains all non-working purposes are considered together.

13 It should be remembered that stops below 10 minutes are considered part of the same trip in the journey, so some additional purposes (e.g. picking up someone) could be "hidden" within the trip chain.

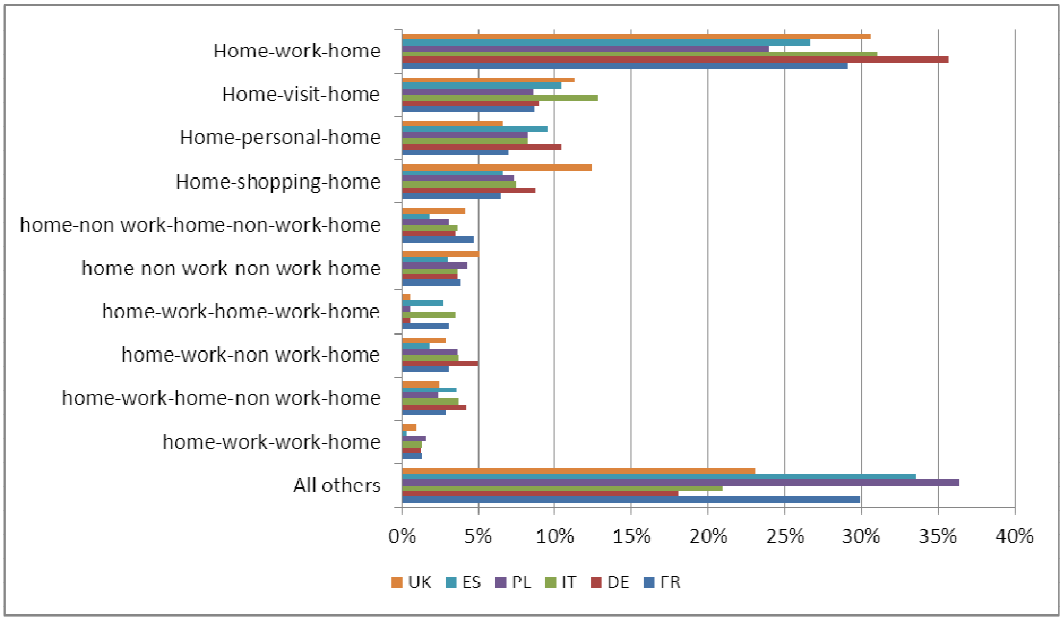


Figure 4.10 Frequency of trip chains by purpose in the six countries.

There are also some differences across countries though. One is that in Spain, Italy and France there is some share of individuals who return home in between of the working day, whereas in the other three countries the chain home-work-home-work-home is irrelevant. In UK the trip chain home-shopping-home is the second most relevant after home-work-home, while in most of the other countries, visit and leisure trips are more frequent. Furthermore, in UK, Italy and especially Germany a higher share of mobility is explained by a relatively limited number of chains like those presented in Figure 4.10. Instead, in France, Spain and especially Poland, there is a higher share of chains not covered by the categories specifically considered in the figure.

Returning to similarities across countries, we already noticed above is that less trips are made on Sunday. Figure 4.11 shows that in all countries the share of individuals making not more than two trips is always higher on Sunday than on other days of the week. Another similarity is that the most common trip chain, made of two trips, is slightly less common for women than for men (Figure 4.12).

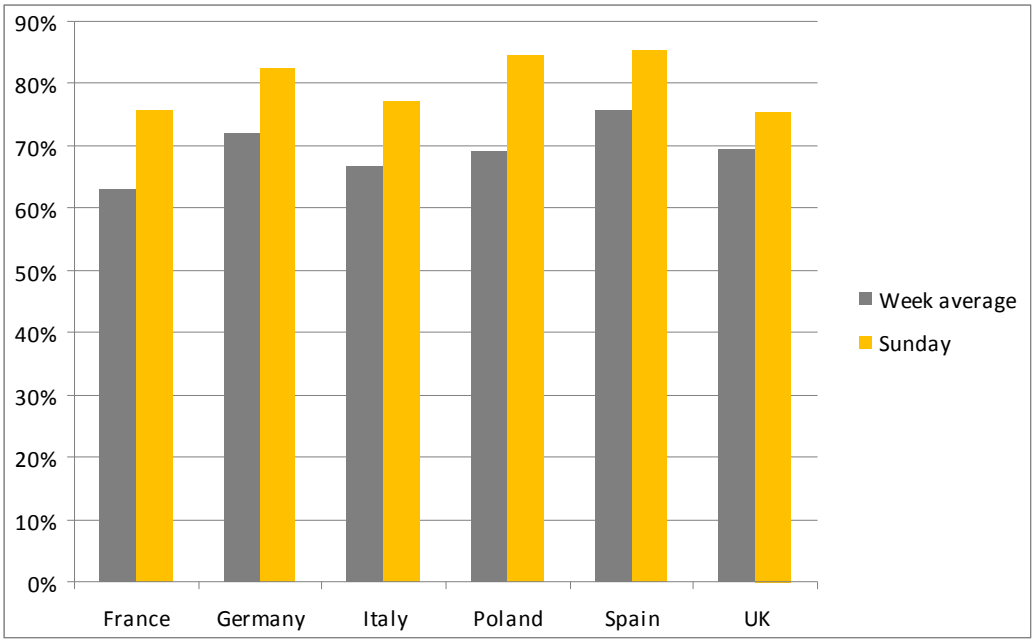


Figure 4.11 Share of individuals making one or two trips on Sunday.

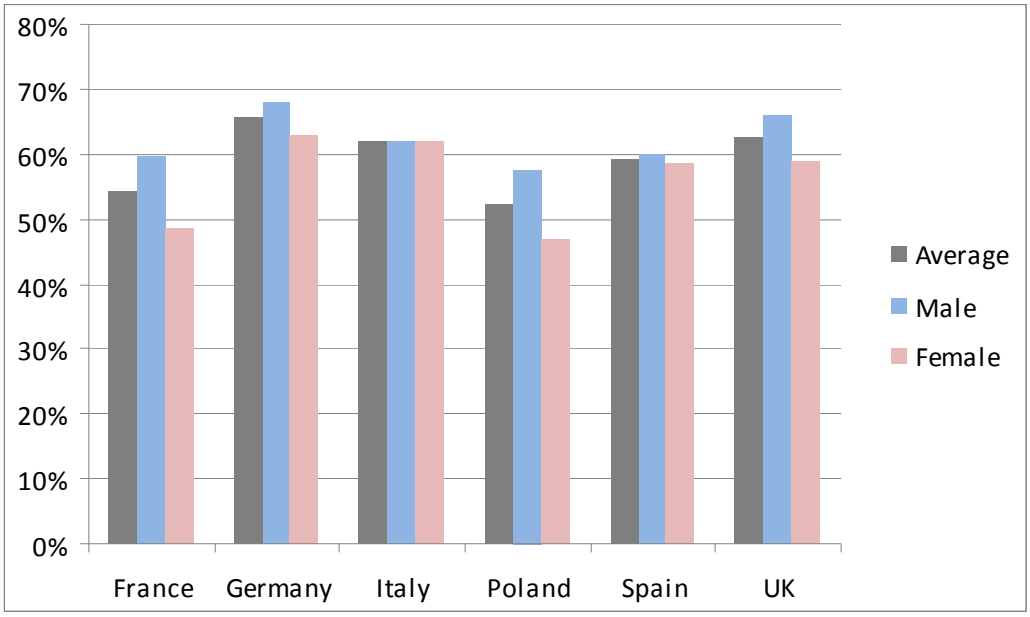


Figure 4.12 Share of two trips chains by gender.

In all countries but Italy, the share of two-trip chains on female car mobility is below the average. The difference is statistically significant in France, Germany, Poland and UK, while it is not in Spain. This difference suggests that women are more often engaged in non-systematic car trips. Indeed, they do more often just one trip per day (with the exception of Germany) but also three trips or more. Shares are not that diverse for the two genders, so talking of a totally different mobility pattern seems unjustified, but this is an aspect that might be worth to explore in more depth using the survey data.
Also age seems to have some influence on how the car is used. Namely, younger individuals are more frequently making two car trips per day (Figure 4.13) whereas people in the middle of their active life are more frequently doing more than three car trips in the same day (Figure 4.14). It should be mentioned however that such differences are not very robust in statistical terms. For instance, the differences in France are not statistically significant while those in Italy are. Again, further analysis is needed before one can conclude that at different ages car mobility patterns change even though it is realistic that younger people (who more often do not own a car and have to share one with a relative) make less trips per day and that mature individuals (who generally are car owners and often hold working and familiar responsibilities besides having an active social life) make more trips.

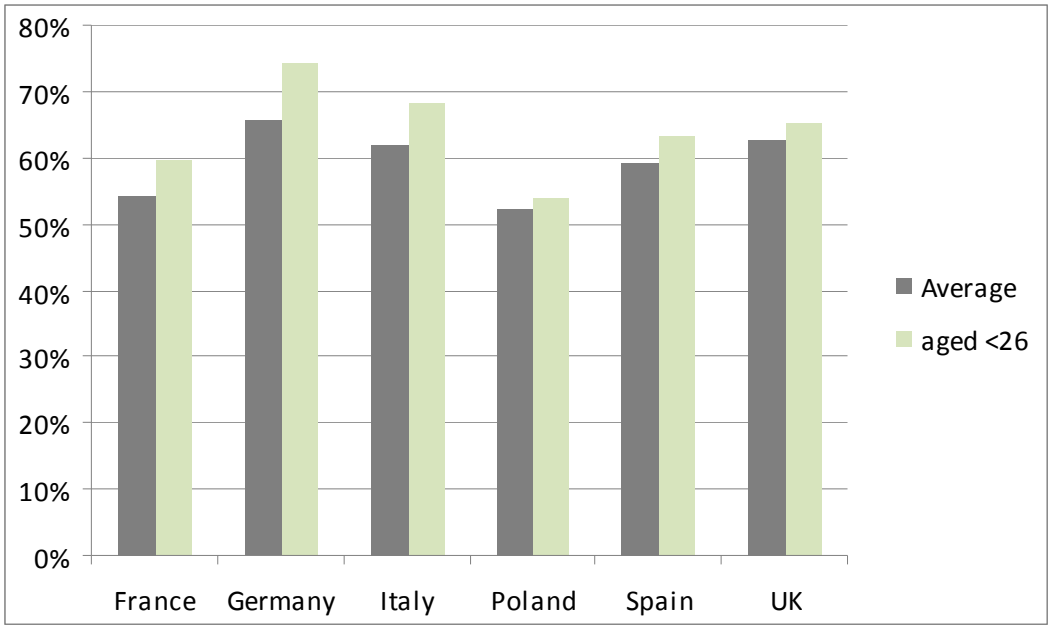


Figure 4.13 Share of two trips chains for individuals aged < 26 years.

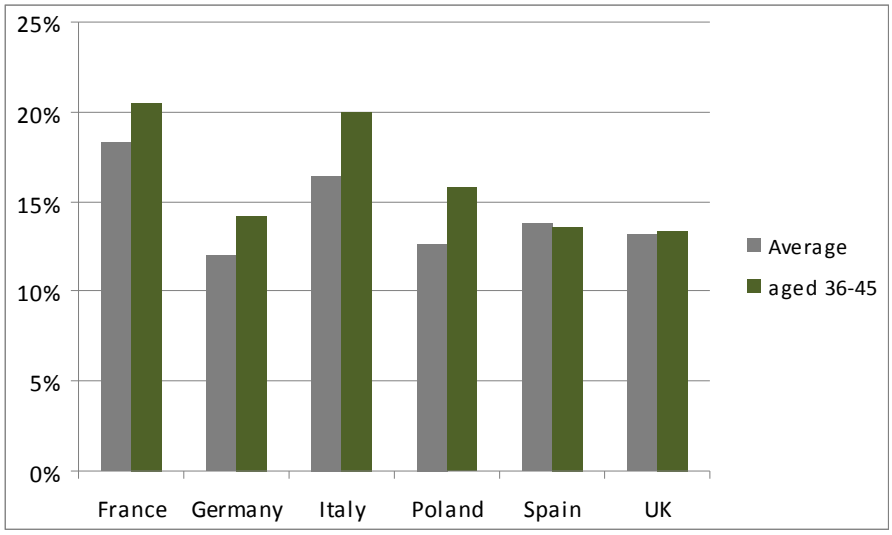


Figure 4.14 Share of four trips chains for individuals aged 36-45 years.

The professional condition seems also relevant to define the car usage profile of individuals. Self-employed persons, especially if in lower positions[14], are more frequently involved in more trip chains than two per day. For instance they do six trips per day more frequently than the average (Figure 4.15) in all countries and at least in four out of six countries the difference is statistically significant.

[14] Lower position means with a lower average income but also with less possibility to hand over tasks. The classification of working positions is based on the items collected with the survey. Self-employed workers in higher positions are considered business owners, entrepreneurs and registered freelance professionals. All other self-employed workers are considered in lower positions.

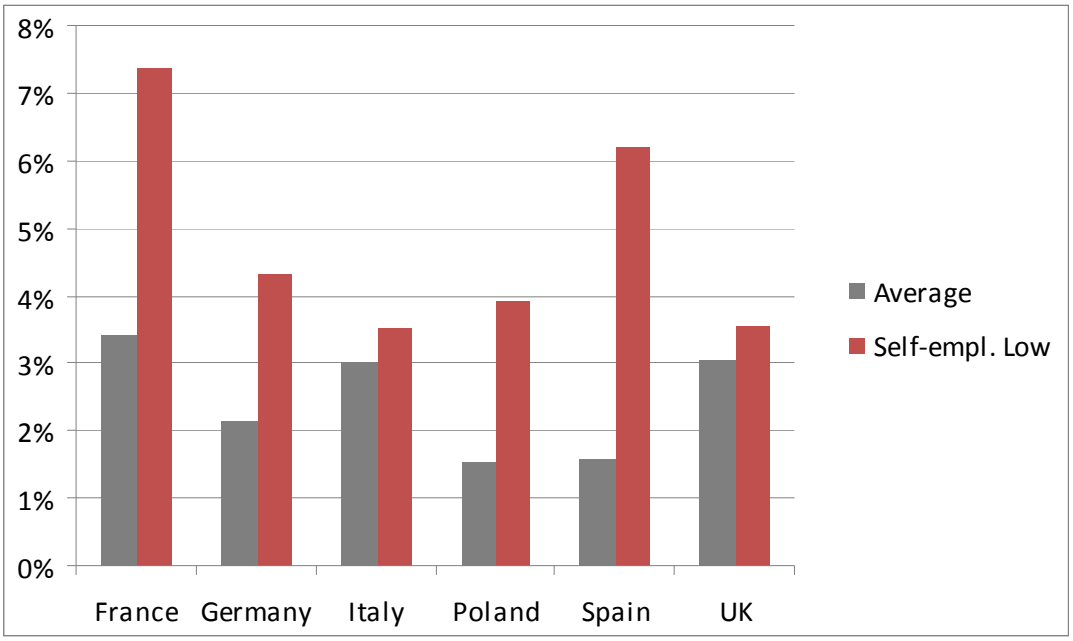


Figure 4.15 Share of six-trip chains for "self-employed low" individuals.

Also the place where people live can make a difference on how much the car is used. Namely, in metropolitan areas there are trip chains with low number of trips per journey (one or two trips as shown in Figure 4.16) whereas in rural areas longer chains are more frequent than on average (Figure 4.17 shows the difference for the four trips chains). The differences are small and not necessarily statistically significant (e.g. in Germany and UK the difference in the share of short trip chains with respect to the average is not significant). Furthermore, Poland and UK show some discrepancy: in Poland the share of short trip[15] chains in metropolitan areas is lower than the average, while in rural areas of UK four trip chains are less frequent than the UK national average.
The influence of the living are seems more limited than one might expect. However it should be considered that the data refers to the behaviour of those that in each area type use car actively. Most likely, in metropolitan areas the share of car users is much lower than in rural areas because public transport supplies more alternatives. This is probably the major difference between the living areas. When one restricts the analysis to those who use car routinely, their behaviour is more similar irrespective the area they live in.

[15] Short trip chains mean trip chains with low number of trips per journey

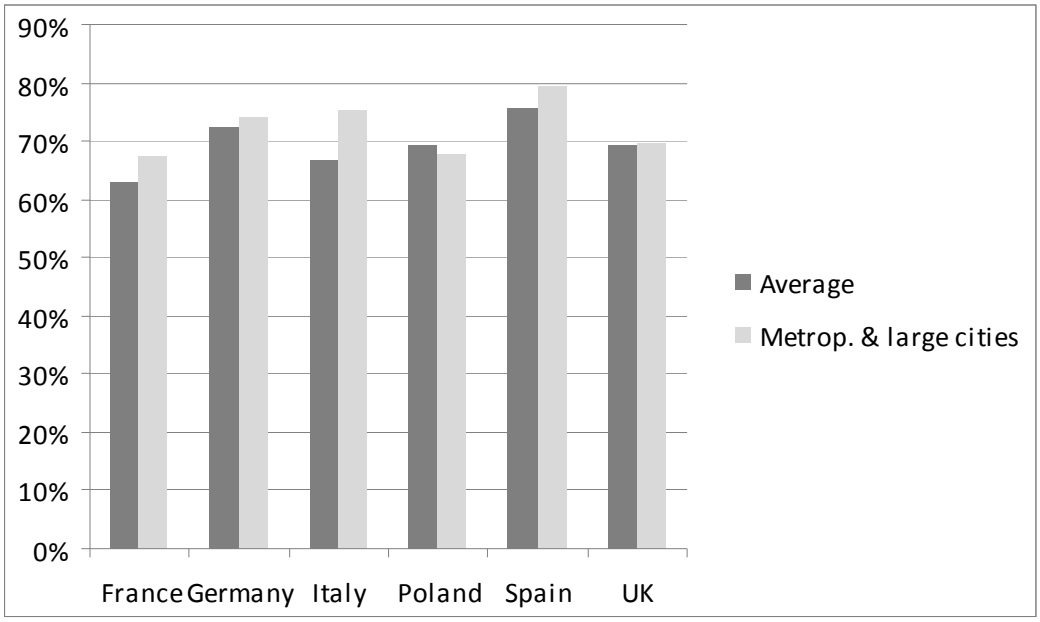


Figure 4.16 Share of one and two trips chains in metropolitan areas.

From a different perspective, the trip chains can be analysed for their different features to highlight whether they are similar across countries. For instance, Figure 4.18 shows the share of trip chains in which the total daily driven distance is below 50 km in the different countries. The pattern is very similar in all countries. The highest share is for the two trips chains and decreases progressively as the number of trips per day increases. Individuals who make more trips travel over longer distances.

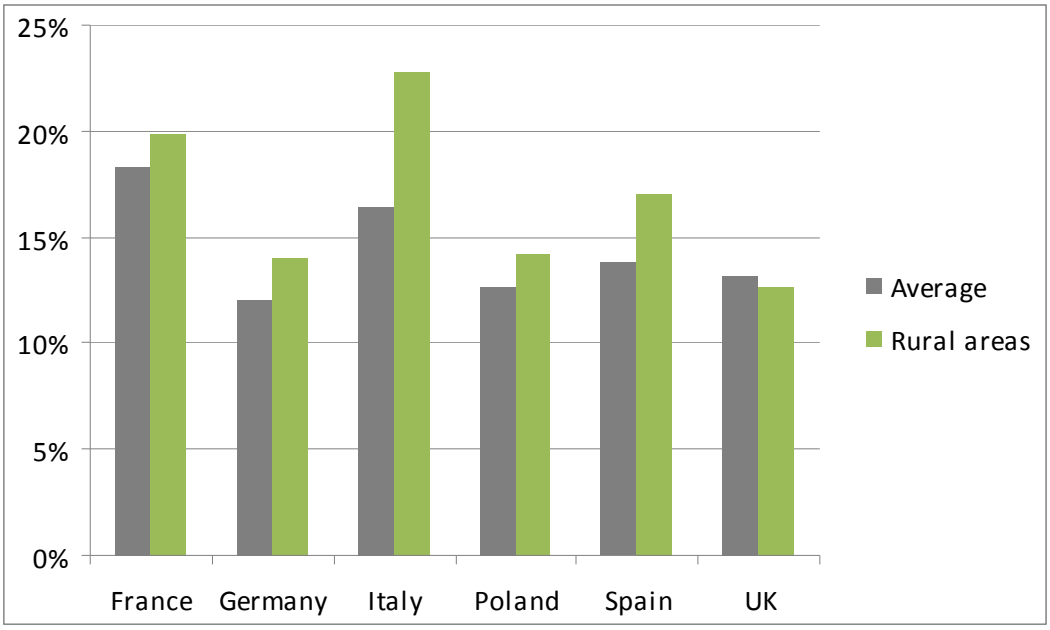


Figure 4.17 Share of four trips chains in rural areas.

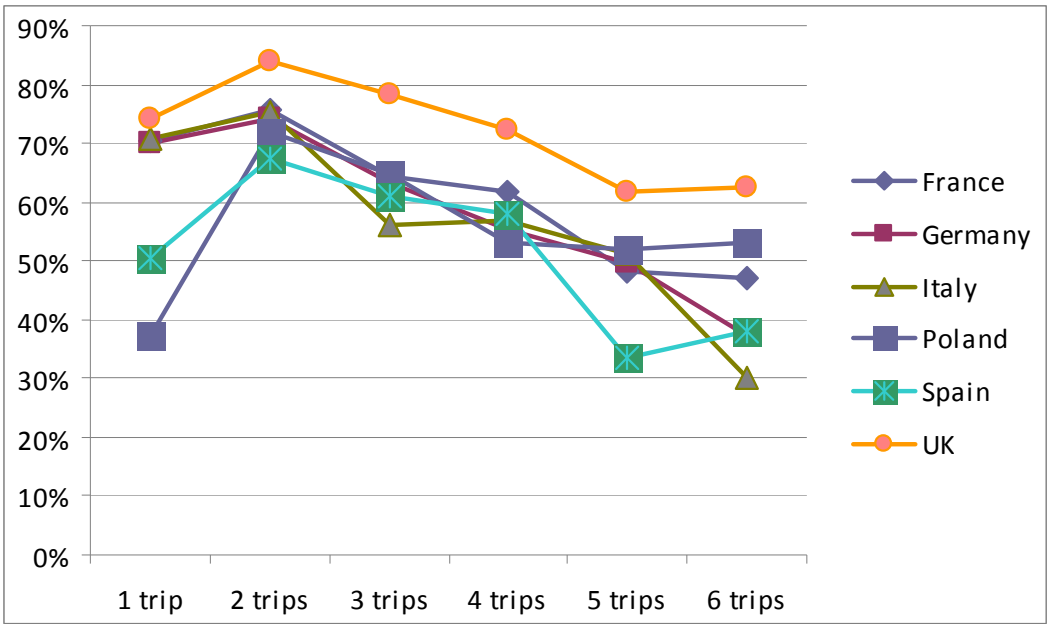


Figure 4.18 Share of trips chains with a total daily driven distance < 50 km.

Individuals making more car trips do not only drive over longer distances, they also drive over a longer time. This is shown in detail in Figure 4.19. The large differences concerning the one trip chains are remarkable. They clearly depend on the share of long trips. In Poland and Spain, a significant share of single trips are parts of longer journeys, while in UK or Italy most of them are local movements.

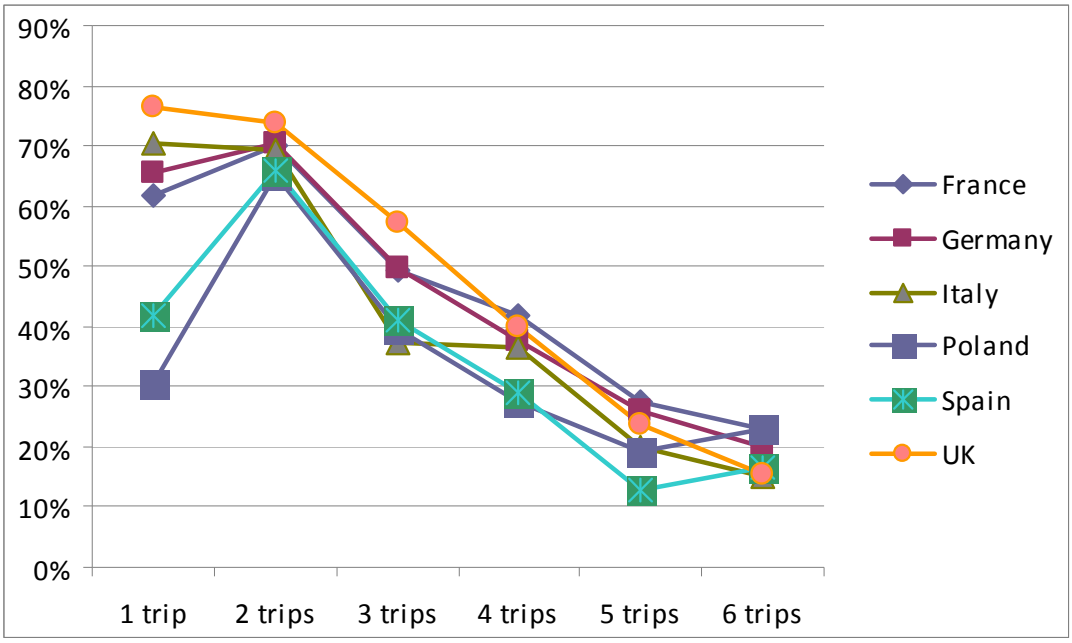


Figure 4.19 Share of trips chains with a driven time < 1 hour. Source: Derived from the collected data through our survey

All the charts and figures presented in this section are just simple examples of the kind of analysis which can be made using the trip diaries data collected with the survey explained in this report. Although the detailed description of driving behaviour was not the primary goal of the survey, its outcome provides a rich database of information to explore how individuals of six different countries use their car. Furthermore, this database is obtained using a common methodology in all countries, which makes comparisons easier. Clearly, this survey cannot replace (and is not intended to do so) the large national surveys carried out in many of these countries. Nevertheless, we are confident that the results of our survey can be helpful and informative both in the larger sense of driving paterns understanding and for estimation of daily charging profiles and load profiles under the assumption that electric vehicles are used for personal mobility and car usage patterns of electric car drivers remain similar to those of conventional car drivers. The JRC technical report on “Attitude of European car drivers towards electric vehicles” (Thiel et al 2012) is

devoted to explore the attitude of individuals towards electric cars based on the same sample used for present report. While potential scenarios of various load profiles calculated based on the obtained data are explored in the JRC report “Electric Vehicle Load Profiles for Selected EU Countries Based on Travel Survey Data” (Pasaoglu et al, 2012).

5 Conclusions

This report presents a good deal of information on the implementation of the direct survey on driving mobility in six European countries and shows a number of results on the driving behaviour in these six countries.

From a methodological point of view, the survey proved to be challenging. The commitment required from the panellists was considerable to such an extent that many of them gave up and the response rate was low. Asking respondents to fill in a diary for at least 7 consecutive days was the main challenge of the survey, but also the level of detail requested in the trip description was very ambitious. In several cases panellists who completed the survey exhibited some problems in providing precise responses. This resulted in a certain share of coding mistakes which had to be corrected, as well as in a certain share of unreliable records which had to be eliminated. Also, approximated responses were given e.g. concerning time of departure and arrival for trips. Despite in principle it was asked to provide the exact minute, basically all respondents rounded times at the nearest 0 or 5 minute.

The results of the sample survey for Germany and UK compare reasonably well with the data taken from the national travel surveys carried out in these two countries. The picture of the car mobility obtained with the 600 cases of our survey is not so different from the picture taken from surveys with incomparably more resources and with a long record of experience. This evidence is quite encouraging. The main purpose of the survey was to provide the elementary information to estimate individual driving profiles and then charging profiles under the assumption that electric vehicles are used and car usage patterns do not change significantly with electrification. The survey can be considered a good source of information also to better understand how a car is used in the surveyed countries.

Charts and tables presented in this report show that there are several similarities across countries (e.g., the large prevalence of trips originating from home, the relatively low distance travelled on average every day by car, the long time in which the car is parked close to home, etc.). Also some statistically significant differences emerge in terms of trip distribution over the day or average trip distance. These results concern some common statistics computable from the collected data. However, there is much more in the outcome of the survey. Indeed, an important value provided by the survey is the availability of a detailed database of individual weekly driving behaviours for six countries (with data collected by applying the same methodology and definitions for all the six countries). Using this database a number of different questions can be addressed: differences across genders, differences between countries, relevance of trip chains by purpose and so on.

In brief, this survey cannot replace the data of a national travel survey, neither in terms of reliability nor in terms of precision and detail. However, it provides reasonable driving profiles for estimating future charging profiles of electric vehicles and many other indications on how people use their car. Last but not least, this survey can provide relevant methodological hints to develop similar surveys in other contexts or to repeat the survey in more countries. Lessons on participation rate, on the administration of the survey (e.g. periods when respondents were allowed to connect and fill in the questionnaire, reminder messages) on the length and complexity of the questionnaire (e.g. the request of code the driving time with a precision at minute), on the definition of the survey scope (e.g. only trips made as driver), on questions regarding wording (e.g. the definition of purposes or of the parking places) etc. could be of help to design new surveys in the future.

Several conclusions can be derived in terms of the significance of driving patterns in relation to the potential use/substitution of a larger portion of the car fleet with electric drive vehicles. In particular, the average distance that is daily driven in 6 members states ranges from an average of 40 km (UK) to an average of 80 km (Poland). Such distances can be comfortably covered by battery electric vehicles that are currently already available on the market. Further R&D improvements in battery systems could ensure that the "range anxiety" factor is minimized. Considering the long recharging time of the energy storage systems of an EDV, the duration of the parking profiles is a good indicator for the estimation of potential recharge time availability. In our survey it has been revealed that the parking time after the last trip of a day amounts to more than 16 hours per day. This duration is more than sufficient to comply with the potential need for a full slow recharge of an average EDV battery. Also, almost 10% of the drivers in the survey park in a private garage or their home, places where a recharging point could easily be installed. The active parking time, defined as the parking periods between which the car is used during a day for several purposes, amounts to 6 hours. This time would be suitable for a potential fast charging or topping up the charge at a convenient place, which is reported for the active parking period mostly as parking at public areas, public parking, reserved parking places at work or regulated and unregulated kerbside parking. On the contrary to what could be a common perception for driving patterns during a weekend (i.e. possible longer trips in suburbs or for other recreational purposes), in our survey a low mobility level during weekends (Saturday and Sunday) has been registered. Indeed, our survey finds that the average daily driving distance does not significantly increase over the weekends, indicating that electric vehicles could not only cover the typical driver needs during weekdays but also the weekends.

Overall it seems that the driving and parking patterns of the current drivers in the 6 Member States that are included in the study are compatible with a potential larger scale introduction of EDVs on the market.

6 References

- Department for Transport (2009): National Travel Survey 2008 - Technical Report. London.
- JRC - Joint Research Centre-EUCAR-CONCAWE collaboration (2011), Well-to-Wheels Appendix 2, WTW GHG Emissions of Externally Chargeable Electric Vehicles. Version 3c.
- MID, (Mobilität in Deutschland), 2008, Basisstichprobe Deutschland, Datensätze, Tabellen, Methodenbericht, Nutzerhandbuch und Ergebnisbericht in.
- Department for Transport, 2012 http://www.dft.gov.uk/statistics/series/national-travel-survey (last accessed 11.07.2012), (2012).
- Thiel C., Alemanno A., Scarcella G., Zubaryeva A., Pasaoglu G. Attitude of European car drivers towards electric vehicles: a survey. JRC report.
- Pasaoglu G., Fiorello D., Zani L., Thiel C., Zubaryeva A. 2012. Projections for Electric Vehicle Load Profiles in Europe-Based on Travel Survey Data,JRC report.

7 Annex 1: The final questionnaire

Pre-SCREENING QUESTIONS

DISPLAY: Before filling in the questionnaire please answer the following questions.

ACC1)Are you expecting to use the car for at least 2 days next week? *(Please select one answer only)*

Yes → Continue
No → THANK AND CLOSE (INVALID INTERVIEW)

ACC2) Next week you will be required to fill in your personal TRAVEL DIARY each day, for 7 consecutive days. Do you agree to do so? *(Please select one answer only)*

Yes → Continue
No → THANK AND CLOSE (INVALID INTERVIEW)

ACC3) You will receive your gift ONLY after you have duly–completed the whole of the questionnaire, including the 7-day TRAVEL DIARY. Do you accept this condition?

Yes → Continue
No → THANK AND CLOSE (INVALID INTERVIEW)

Next screen

QINTROnew.

Good day and welcome to the questionnaire on the English people's driving habits.
This survey is being conducted in 6 European countries. Its purpose is to improve the quality of urban transport, the environment and the quality of life of the people in your country.
Lots of other people, throughout Europe, are taking part in this survey and we would be grateful if you, too, could devote part of your valuable time to give us some information about your car usage habits.
The information you give us will be extremely important for understanding how to improve road travel in each European country involved, which will enable us to implement more suitable policies for improving people's quality of life as a whole.

The questionnaire is divided into three sections.
In the first section, which we would ask you to fill in only once, you are asked to give some information about yourself and about your family, e.g. whether you are a man, a woman, where you live, what educational qualification you hold, etc.
You will have to fill this section in only once, when you receive the questionnaire,

The second section is a diary for you to record how you use your car.
In this section there is a table for each day, to be filled in , every day, for seven consecutive days, with all the car journeys you make on that particular day.

To make this detailed task easier for you, please print the attached table (SCRIPT: MAKE A LINK TO THE CORRESPONDENT ISTRUCTION + TABLE), which must be filled in with important information for the diary: departure time, time of arrival and the distance covered in KM. These information must be noted for all the journeys you make in the day.

The third section, asks for information about electric cars in general and you are required to fill it in only once, on the last day of the survey.

Thank you for your valuable assistance!
The Ipsos Team

NEXT SCREEN

SCRIPT: THIS SECTION WILL BE ASKED ONCE

DISPLAY: First of all we want you to provide us with some information about yourself. We remind you that you need to complete this section only once.

SCREENING QUESTIONS

Section 1: information about respondent

S1 [Gender] Are you… (Please select one answer only)

1 Male

2 Female

S2 [Age] How old are you? (Please write in the space below)

|__|__| Years (script: range 18 y.o. and over)

S3) Do you hold a full driving licence valid in your country to drive either a car, or ride a motorcycle, scooter or moped? (You can select one or more answers)

Yes , to drive a car

Yes, to ride a motorcycle, scooter, moped

No → THANK AND CLOSE (INVALID INTERVIEW) (SINGLE ANSWER)

SCRIPT: IF CODE 1 IS NOT SELECTED AT S3 THANK AND CLOSE (INVALID INTERVIEW)

(Ask all)

S3b) In the last 4 weeks have you driven a car including any you do not personally own? (Please select one answer only)

Yes my own car→ ask S3bis

Yes, not my own car→ ask S3bis

NO → → THANK AND CLOSE (INVALID INTERVIEW)

S3bis) Do you regularly drive a car? (please select one answer only)

1 Yes, every day → CONTINUE

2 Yes, almost every day → CONTINUE

3 Yes, at least once a week → CONTINUE

4 NO, only occasionally → THANK AND CLOSE (INVALID INTERVIEW)

S4) How would you describe *the area you live in? (please select one answer only)*

1 Metropolitan area → ask S4bis

2 Large city → go to S4Quater

3 Large town → ask S4ter

4 Small town → ask S4ter

5 Rural area→ ask S4ter

(Ask if code1 at S4)

S4bis) Do you live … (please select one answer only)

1 In the centre of the city

2 in the suburbs

(Ask if codes 3 or 4 or 5 at S4)

S4ter) Do you live … (please select one answer only)

1. Very close to a big city (within a radius of approx. 10km or less)

2. Near to a big city (within a radius of 11 to 40 Km)

3. Far from a big city (outside a radius of 40KM or more)

(Ask all)

S4quater) Would you say the area in which you live is … (please select one answer only)

1. well served by public transport?

2. partially served by public transport?

3. not well served by public transport, OR difficult to reach?

S5 Was your highest qualification…*(Please select one answer only)*

degree level or higher

another kind of qualification

S5b How old were you when you left full-time education? *(Please select one answer only)*

1. • younger than 17
2. • 17 to 18 years old
3. • 19 to 22 years old
4. • 23 or older
5. • I'm still studying

S6). What is your employment status? (Please select one answer only)

business owner/entrepreneur

registered freelance professional

company director/CEO

office worker

middle manager

storekeeper/tradesman/craftsman

manual worker/agricultural worker/farmer

other self-employed worker

other employed worker

teacher/lecturer

student

housewife

retired

unemployed

MAIN QUESTIONNARIE

(If EMPLOYED or Student= code from 1 to 11 at S6: ask)

D1) Do you usually commute by car? (Please select one answer only)

1 Yes, every day

2 Yes, almost every day

3 Yes, sometimes

4 No, never or hardly ever

(If code 1 or 2 at D1: ask)

D1bis) When you go to work or school, do you usually use … (Please select one answer only)

The car only

The car together with another form of public transport

(If code 2 at D1bis: ask)

D1ter What other form of public transport do you use in addition to the car? (You can select one or more answers)

Train

Underground

Light train

Tram

Bus

Bicycle

(If EMPLOYED= code from 1 to 10 at S6: ask)

D2) The journey to work is the most frequently travelled journey for many people. Thinking about your job, when you go to work do you... (Please select one answer only)

go to the same place every time

go to the same place on at least 2 days running each week

go to different places

work at home or in the same building or grounds as your home.

(If EMPLOYED= code from 1 to 10 at S6: ask)

D3 How often, if at all, do you work from home instead of going to your (usual) place of work? (Please select one answer only)

3 or more times a week

Once or twice a week

Less than that but more than twice a month

Once or twice a month

Less than that but more than twice a year

Once or twice a year

Less than that or never

(If EMPLOYED= code from 1 to 10 at S6: ask)

D4) Some companies have a car-pool from which employees take a car when they need one. Does anyone in your household, including you, use cars from a company car-pool? NOTE: AS A DRIVER

Yes

No

(Ask all)

D5) How many vehicles does your household own or have continuous use of at present? Please: also count any vehicles currently being repaired which may be in use from next week or cars of a company carpool. (please write in the space below)

|___|___| (range from 0 to 10)

(SCRIPT: ASK ALL)

D6) How many cars do you usually drive? Note: please include also the cars from a company car-pool, or friends', relatives', parents' cars that you are used to driving sometimes (meaning more than once a month)

|___|___| (range from 1 to 10)

(Ask all)

D7) Do you usually drive … (Please select one or more answers)

...an ordinary car (without special adaptations for people with disabilities),

...a car with special adaptations for people with disabilities

... some other kind of vehicle?

D8) Do you usually drive the same car? (Please select one answer only)

1 Yes, always the same

2 Yes, with rare exceptions

3 No, I can choose from several cars

D9) Are you planning to buy a new car in the future? (Please select one answer only)

1 Yes, next week

2 Yes, in the next 6 months

3 Yes, in the next 12-24 months

4 Yes, in the next 3-5 years

5 No

NEXT SCREEN

DISPLAY: We would now like you to give detailed descriptions of the cars that you regularly drive. Please mark the make, model, engine size, fuel type, and age of the vehicle in the table below.

NEXT SCREEN

(SCRIPT: SHOW QF FOR ALL THE CARS LISTED IN D6)

F) Could you describe the car(s) you usually drive?

		Car 1	Car N
var	Code	1	N
B1	Make	*(please select the make from the list)* □ I cannot find the *make* on the list → show F1	
M1	Model	*(please select the model from the list)* □ I cannot find the model on the list → show F1	
F1	Fuel type	1 Gasoline/petrol 2 Diesel 3 LPG 4 CNG 5 Hybrid (part petrol-drive, part electric) 6 Electric 7 Other kind of fuel (SCRIPT: DO NOT SPECIFY)	
E1	Engine size	1 < 1000cc 2 1001-1300cc 3 1301-1600cc 4 1601-2000 cc 5 > 2000 cc 6 Don't Know	

A1	Age	1 Less than 1 year 2 1- 2 years 3 3 – 4 years 4 5 – 6 years 5 6 – 10 years 6 > 10 years	
T1	Type of transmission	Automatic/progressive transmission Manual transmission	
O1	Ownership	Own car Parents' / relatives' / friends' car Company car-pool	

SCRIPT:

Table F must be shown for all the cars indicated by the respondent at D6.

Table F must be shown on the same screen.

For the selection of Brand (B1) and Model (M1) use the corresponding table in Excel.

Respondent will select the brand from a scroll screen.

The model must be filtered according to the brand respondent selected in B1

The check-box "I cannot find the brand/ model on the list" is exclusive (if respondents select the check box, they are not allowed to select brands or model)

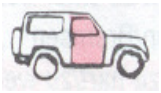
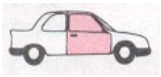
If the check-box is selected for both brand and model, show the following question and the corresponding table

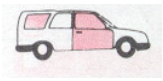
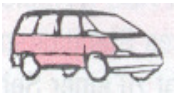
PICTURE

(Show if the check-box in table F is selected for both make and model)

F1) In the table below, please select the picture most similar to the car we're talking about *(please select one answer only)*

Script Show Picture TABLE ON THE SAME SCREEN

encode	PICTURE	Description
1		Compact SUV (small/medium size)
2		Medium-size SUV
3		Saloon – 2 doors, medium size (3 box configuration – separate boot)
4		Saloon – 4 doors, medium size (3 box configuration – separate boot)
5		Hatchback – 3 doors, small-medium size (2 box configuration)
6		Hatchback – 5 doors, small-medium size (2 box configuration)

7		3 door estate car/station wagon
8		5 door estate car/station wagon
9		Coupé
10		Convertible/ cabriolet
11		MPV

NEXT SCREEN

DISPLAY:

Congratulation! You have completed the first section of the questionnaire.

From tomorrow you are allowed to fill in your personal TRAVEL DIARY. Please make sure you start the Travel Diary in the next 3 days (you can start the diary in one of the following days PIPE IN DAY BY ALIN)

After you start the diary over the next 7 days we are asking you to complete the Travel Diary for each car trip you made each day.

Many thanks for your cooperation! See you soon.

The Ipsos Team!

NEXT SCREEN

ON!

Over the next 7 days you will record some information about every car trip you made on each day.
Please read the instructions throughout the questionnaire very carefully; they will be very useful should you have any doubts.

NEXT SCREEN

DISPLAY:

This section is a TRAVEL DIARY in which we are asking you to record all of the car trips (excluding, therefore, any journey made by bus, train, underground etc.) you make each day. Please give the information requested for each trip.

IMPORTANT: WHAT IS MEANT BY CAR TRIP

A car trip is defined as a journey from a starting-point to a destination where the car is left parked for more than 10 minutes. Shorter stops do not constitute different trips. For instance:
leaving home and parking the car close to a coffee bar, entering to have breakfast and leaving after 15 minutes to go to the office. These are two trips: from home to the coffee bar and then from the coffee bar to the office.
leaving home and stopping the car in front of a school for a couple of minutes, to leave a child at school and then continuing on to the office. This is one trip: from home to the office.
Use the paper template attached to this questionnaire for noting down the exact times (departure time and arrival time) and distance (using the odometer) covered on each trip.

NOTE: in the event of long journeys, during which you drive part of the way, consider the point of arrival as the final stage of your journey.

GENERAL INDICATIONS:

INCLUDE ALSO THE DATE (EX. MONDAY 16TH JAN..)

USE THE SAME INDICATION FOR THE DAY IN ALL QUESTIONS (I.E THE NAME OF THE DAY →MONDAY, TUESDAY, ETC OR THE WORD "TODAY")

Day 1 (SCRIPT: EACH DAY MUST BE ADAPTED: Monday / Tuesday / Wednesday / Thursday / Friday / Saturday / Sunday)

Q0 Did you use your car(s) today? *(Please select one answer only)*

Yes

No

SCREEN OUT IF Q0=2 for 7 days

SHOW THIS DISPLAY:

"You said that you would use the car for at least 2 days and you didn't. Unfortunately your answers are of no help to us and this interview could not be considered a valid one. You will not receive any fee for this survey".

SCREEN OUT IF RESPONDENTS DO NOT WRITE UP THE TRAVEL DIARY FOR 3 CONSECUTIVE DAYS

(If code 2 at Q0)

DISPLAY: Thank you very much. This section is complete for today. Please come back tomorrow.

(If code 1 at Q0)

NEXT SCREEN

THE FOLLOWING TABLE WILL BE SHOWN ON THE SAME PAGE.

More templates like this for further trips in the day and for each of the seven days

Day 1 (SCRIPT: EACH DAY MUST BE ADAPTED: Monday / Tuesday / Wednesday / Thursday / Friday / Saturday / Sunday)

DISPLAY: Please indicate in the table below the weather conditions.

		WEATHER CONDITIONS Day 1…
W1	*(Please select one code only)*	● Rain ● Sun ● Variable
W2	*(You can select one or more answers)*	● Snow ● Fog ● Ice ● Wind ● None of these (script: single answer)
W3	Outside temperature *(please select one code only)*	● Hot ● Cold ● Mild

NEXT SCREEN

Day 1 (SCRIPT: EACH DAY MUST BE ADAPTED: Monday / Tuesday / Wednesday / Thursday / Friday / Saturday / Sunday)

Q.1) Did you use the same car for all the trips? *(Please select one code only)*

Yes → skip to Q3

No

(Ask if Q1=2)

Q.2) Which car or cars did you use on your trips today? (You can select one or more answer)

CAR 1

CAR 2

CAR 3

CAR N….

SCRIPT: SHOW THE CARS SELECTED BY RESPONDENT IN TABLE F) BRAND AND MODEL.

(Ask if code 1 at Q.1)

Q.3) Did anyone else use this car as well today? (Please select one code only)

1. Yes, before I did
2. Yes, after I did
3, Yes, both before and after I did
4. No
5. I don't know

(Ask if code 2 at Q.2)

Q.3BIS) Did anyone else use the car <SCRIPT: INSERT THE SELECTED CAR IN Q2> as well today? (Please select one code only)

1. Yes, before I did
2. Yes, after I did
3, Yes, both before and after I did
4. No
5. I don't know

SCRIPT: SHOW Q.3BIS FOR EACH CAR SELECTED AT Q.2

NEXT SCREEN

(ASK ALL RESPONDENTS)

Q.4) How many car trips did you make today?

Please remember that *a car trip is defined as a journey from a starting-point to a destination where the car is left parked for more than 10 minutes.*

(Please write in the space below a figure from 1 to 20)

|___|___| (range from 1 to 20)

SCRIPT: PLEASE SHOW THE NEXT TABLE FOR EACH TRIP INDICATED AT Q.4

NEXT SCREEN

DISPLAY:

Now, for each trip made today, please provide some simple information such as: purpose of the trip, departure place, place of arrival, distance and so on.

Please try to be as precise as possible, in particular when recording times (start and arrival) as well as the distance covered.

SCRIPT:

CHECK CONSISTENCY BETWEEN DEPARTURE TIME AND ARRIVAL TIME: STARTING TIME MUST BE < THAN ARRIVAL TIME

START TIME 21.00 ARRIVAL TIME 21.05 → OK

START TIME 21.00 ARRIVAL TIME 20.00 → WRONG

CHECK CONSISTENCY BETWEEN DISTANCE COVERED BETWEEN START POINT AND PLACE OF ARRIVAL: DISTANCE COVERED AT PLACE OF ARRIVAL MUST BE > THAT THAT INDICATED AT START POINT

START POINT 12000 PLACE OF ARRIVAL 12003 → OK

START POINT 12000 PLACE OF ARRIVAL 11003 → WRONG

SCRIPT: THE FOLLOWING TABLE MUST BE SHOWN ON THE SAME PAGE.

More templates like this for further trips in the day and for each of the seven days

(SCRIPT: EACH DAY MUST BE ADAPTED: Monday / Tuesday / Wednesday / Thursday / Friday / Saturday / Sunday)

Trip ID: 1	Car used (SCRIPT SEE INSTRUCTION BELOW) *(Please select the car you used for THIS trip – one answer only)*
T1	Purpose *(Please select one code only)* 1 Commuting to work/school 2 Work-related business 3 Personal business 4 Visiting friends/ relatives 5 Shopping 6 Leisure (sport) 7-Accompanying someone 8 Returning home 9 Other → SCRIPT: DO NOT SPECIFY
T2	Start point *(Please select one code only)*

	1 Home 2 Relatives'/friends' home 3 Work place/school 4 Shop 5 Public office/Private office 6 Public place (e.g. theatre, swimming pool) 7 Park-and-ride car park 8 Other → SCRIPT: DO NOT SPECIFY
T3	Parking Place *(Please select one code only)* 1-Kerbside, regulated parking 2 Kerbside, unregulated parking 3 On a drive way 4 Reserved firm/work parking area 5 Open air private parking area 6 Open air public parking area 7 Private garage 8 Public garage 9 Park-and-ride car park 10 Own private space at home 11 Own private garage at home

T4	Departure time *Please record your exact starting time: hh:mm (24H)* ___:___
T5	Arrival time *Please record your exact arrival time: hh:mm (24H)* ___:___
T6	Place of arrival *(Please select one code only)* 1 Home 2 Relatives'/friends' home 3 Work place/school 4 Shop 5 Public office/Private office 6 Public place (e.g. theatre, swimming pool) 7 Park-and-ride car park 8 Other → SCRIPT: DO NOT SPECIFY
T7	Distance covered *(Please record the initial and final KM shown on the odometer)* Start point : _____ km shown on the odometer Place of arrival: _____ km shown on the odometer
T8	Number of stops lasting less than 10 minutes made during the trip |__|__| range from 0 to 10
T9	Number of passengers carried during the trip in addition to the driver *(Please enter a number from 0 to 8)* |__|__| range from 0 to 8
T10	*(If distance covered in one trip is more than 50 KM)* Did you take the motorway / highway? Yes No I didn't cover this distance on this trip

T4. PLEASE MAKE SURE THAT EACH TRIP BEGINS AFTER THE PREVIOUS ONE ENDED
T7. PLEASE MAKE SURE THAT IF THEY USE THE SAME CAR FOR SEVERAL TRIPS THE NUMBER OF KILOMETRES IS HIGHER IN SUBSEQUENT TRIPS.

SCRIPT: FOR THE VARIABLE "PARKING PLACE" SHOW THE FOLLOWING PARKING DEFINITIONS FOR THE RESPONDENT THROUGH THE "MOUSE OVER"

1 Kerbside, regulated parking

On the side of a public street *specifically dedicated to parking*, e.g. with parking lots marked out by painted lines. Parking in these spaces can be either free or charged.

2 Kerbside, unregulated parking

On the side of a *public street* where *parking is allowed*, but lots *are not marked* in any way and parking is free or also where parking is, in theory at least, not allowed but tolerated.

3 On a driveway

On the side of a *driveway* where parking is allowed or also where parking is, in theory at least, not allowed but tolerated.

4 Reserved firm/work parking area

A parking space made available at your workplace or nearby and reserved for you or your colleagues.

5 Open-air private parking area

An *open-air area specifically dedicated to parking*, *either free or charged* (including parking for clients and visitors of a private activity such as a shopping centre or an airport)

6 Open-air public parking area

An *open-air area specifically dedicated to parking, either free or charged, managed by local authorities or public operators (including parking for clients and visitors of public places* such as *hospitals or stations)*

7 Private garage

A *garage, either free or charged, managed by a private operator (including parking for clients and visitors of a private activity* such as *a shopping centre park or an airport)*

8 Public garage

A *garage, either free or charged, managed by local authorities or public operators (including parking for clients and visitors of public places such as hospitals or stations)*

9 Park-and-ride car park

This alternative means that you have parked the car in an area (open-air or covered) specifically dedicated to those who make use of transit services to complete their trip.

10 Own private space at home

~~A~~ personally parking space inside your own property, open-air (e.g. in the backyard).

11 Own private garage at home

A personally own garage inside your property.

SCRIPT: CHECK CONSISTENCY BETWEEN STARTING PLACE AND PLACE OF ARRIVAL.
EXAMPLE:
THE STARTING PLACE OF THE 2ND TRIP MUST BE THE ARRIVAL PLACE OF THE 1ST TRIP.
THE STARTING PLACE OF THE 3RD TRIP MUST BE THE ARRIVAL PLACE OF THE 2ND TRIP
ETC
NEXT SCREEN

(SHOW ALL)
DISPLAY TO BE SHOWN AT THE END OF THE 7TH DAY, AFTER COMPLETION OF THE TRAVEL DIARY.

DISPLAY:

Congratulations! You have correctly completed the TRAVEL DIARY SECTION!

NEXT SCREEN

The attitude survey questionnaire is provided in "Attitude of European car drivers towards electric vehicles: a survey" (Thiel et al, 2012).

8 Annex 2: Statistical data sources

Gender and age distribution

All countries: EUROSTAT: Population on 1 January by five years age groups and gender (table: demo_pjangroup)

Web-page: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

Note: for France the territorial area considered is that of Metropolitan France, i.e. Continental France and the islands in the Atlantic, the English Channel, and the Mediterranean (including Corsica) accessed on October 2012

Geographical area

France, Germany, Poland, **UK**: EUROSTAT Population at 1st January by gender and age from 1990 onwards (table: demo_r_d2jan)

Web-page: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database assessed accessed on October 2012

Italy*:* ISTAT Resident population as at 01 January 2011 by age, gender, and marital status

Web-page: http://demo.istat.it/pop2011/index.html accessed on October 2012

Spain*:* INE - Istituto National de Estadìstica Population Figures as at 01/01/2010. Royal Decree 1612/2009, 07 December

Web-page: http://www.ine.es/jaxi/tabla.do accessed on October 2012

Note: the Eurostat statistics are available for the distribution by geographical area of the whole population and not on age basis.

City size

France: INSEE (TAILLE AGGLOMERATION – Y. 2007)

Web-page: http://www.bdm.insee.fr/bdm2/choixTheme.action?code=44 accessed on October 2012

Germany: Source: INTERNAL SOURCE – IPSOS (pop. 18+ y.o. year 2003)

Italy: Source: ISTAT (resident population as of 01 January 2011 by age, gender, and marital status)
Web-page: http://demo.istat.it/pop2011/index.html accessed on October 2012

Poland: Source: GLOWNY URZAD STATYSTYCZNY (Central Statistical Office) – Demographic Yearbook of Poland 2011
Web-page:
http://www.stat.gov.pl/cps/rde/xbcr/gus/PUBL_sy_demographic_yearbook_2011.pdf
accessed on October 2012

Spain: Source: INE - Istituto National de Estadìstica- Population figures as at 01/01/2010. Royal Decree 1612/2009, 07 December
Web-page: http://www.ine.es/jaxi/tabla.do accessed on October 2012

UK: Source: ONS. Mid-2010 Population Estimates

Level of education:
All countries: EUROSTAT 2010 Persons with tertiary education attainment by age and gender (%) (table: edat_lfse_07)
Web-page: http://appsso.eurostat.ec.europa.eu/nui/show.do accessed on October 2012

Occupational status:
All countries: EUROSTAT 2011 – 2nd quarter. Population by gender, age, nationality, and occupational status (table: lfsq_pganws)
Web-page: http://appsso.eurostat.ec.europa.eu/nui/show.do accessed on October 2012

Note: the data provided by EUROSTAT refers to the number of occupied individuals for each country of interest, in absolute values, calculated on the total population aged 15 and over. The required percentage of occupied for each country was reconstructed on the basis of the total population of each country.

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Abstract

The development of innovative vehicles such as electric driven cars is an important potential option for improving the sustainability of the transport sector. A significant penetration of electric vehicles in the market is possible only if their use is compatible with mobility patterns of individuals. For instance, the driven distance should be compatible with the batteries range or parking patterns should enable re-charging. The JRC-IET together with TRT and IPSOS analyzed car mobility patterns derived from direct surveys in six European Union Member States (France, Germany, Italy, Poland, Spain and United Kingdom). The report aims at providing some insights on how electric vehicles could fit mobility habits of European car drivers. The analysis is based on the data collected within six European countries by means of a sample survey. A web-based car trips diary was filled in by on average 600 individuals in each country. The individuals logged for 7 consecutive days their driving and parking patterns in 5 minute intervals. For each trip several details such as departure and arrival time, distance and parking place were registered. Socioeconomic characteristics of individuals were also collected. The same questionnaire format was used in all countries allowing for comparability of responses. Representativeness of the derived data was ensured by weighting and aligning the received sample to the socio-demographic reference universe of each member state. Survey results are statistically analyzed to describe mobility patterns. In particular, the information on average number of car trips per day, daily travel distance, daily travel time, trip distance, distribution of parking and driving, distribution of parking places, trip purposes, duration of parking and many other parameters per Member State are analyzed and presented in the report. Moreover, the analysis of the survey data shows which share of driving patterns are compatible with the use of electric cars with their current technical features (batteries range, re-charge time) under alternative assumptions about the availability of re-charge facilities. Also differences and similarities between countries and user groups are discussed. Overall, the results of the survey provide representative driving profiles for estimating the charging profiles of electric vehicles and many other indications on how people use their car. The outcomes of the survey provide relevant methodological hints to develop similar surveys in other contexts or to repeat the survey in other countries.

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