Mobile Phone Surveys: Empirical Findings from a Research Project

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The growing number of mobile-only households across Europe and in Northern America is at present one of the key challenges for survey research. So far, frames for telephone survey sampling include only landline phone numbers. But in future landline phone surveys and mobile phone surveys will have to be combined. However, at present there are a lot of practical questions unsolved. In this paper we want to present some findings of a recent research project where we recruited individuals for an experimental mobile phone panel. Our main objective was to study their response behavior.

In the first chapter we explain the motivation for our research. Then we describe the fieldwork of our study in detail to show which efforts are necessary to conduct a mobile phone survey. In the third chapter we show some findings on the response behavior of the panelists. Finally, we give an outlook on future telephone surveys where the dual frame approach will become the usual method.

Key words: sampling for telephone surveys, weighting, dual frame approach, mobile-onlys

1. PROBLEMS IN CURRENT TELEPHONE SURVEYS DUE TO UNDERCOVERAGE

Telephone surveys have been frequently used in survey research in all countries where the equipment of households with landline telephones has reached a level that provides a sufficient coverage. In Germany this is the case since the mid of the 1990th, after the telecommunication infrastructure in East Germany had been established.

**Table 1**   Use of different modes for survey research in Germany (ADM-Institutes)[1] in %

	1990	1995	2000	2005	2009
Face-to-face	65	60	34	24	19
Telephone	22	30	41	45	42
Postal	13	10	22	9	7
Online	-	-	3	22	32

Since the obligation of being listed in the telephone book was cut in 1992 and more and more households used the option of not publishing their telephone number, German sampling experts had to find a solution for a sampling strategy. Thus, the so called Gabler-Häder-Design was developed. The sampling frame consists of a modified Random-Digit-Dialing frame of landline phones with consideration of used blocks of numbers (Gabler/ Häder 2002). However, in the last years a new problem came up: A lot of households abandon their landline phones and rely solely on mobile phones. One possible reason for this is that they do not want to pay basic charges for two different types of phones. Hence, they decide for the mobile phone with its more universal usage. In the figures 1 and 2 one can see that this trend is not true only for Germany but for whole Europe.

As figure 1 shows the problem of "cutting the cord" is valid in Poland even more than in Germany: 34.1% of the population is not reachable in their accommodation via landline phone. This includes people without any phone and those with only mobile phones. 80% of the Polish people own a mobile phone.

Unfortunately, individuals using only mobile phones vary from those who have access to landline phones. In so far the mobile-only-households cannot be seen as missing at random in the landline sampling frame. Mobile-onlys are younger, more frequently men, seldom at home and more frequently living in urban areas.

Figure 1   Usage of landline phones in Europe (Source: European Social Survey, round 4, design weighted data)

Percentage of fixed-line telephone in accommodation
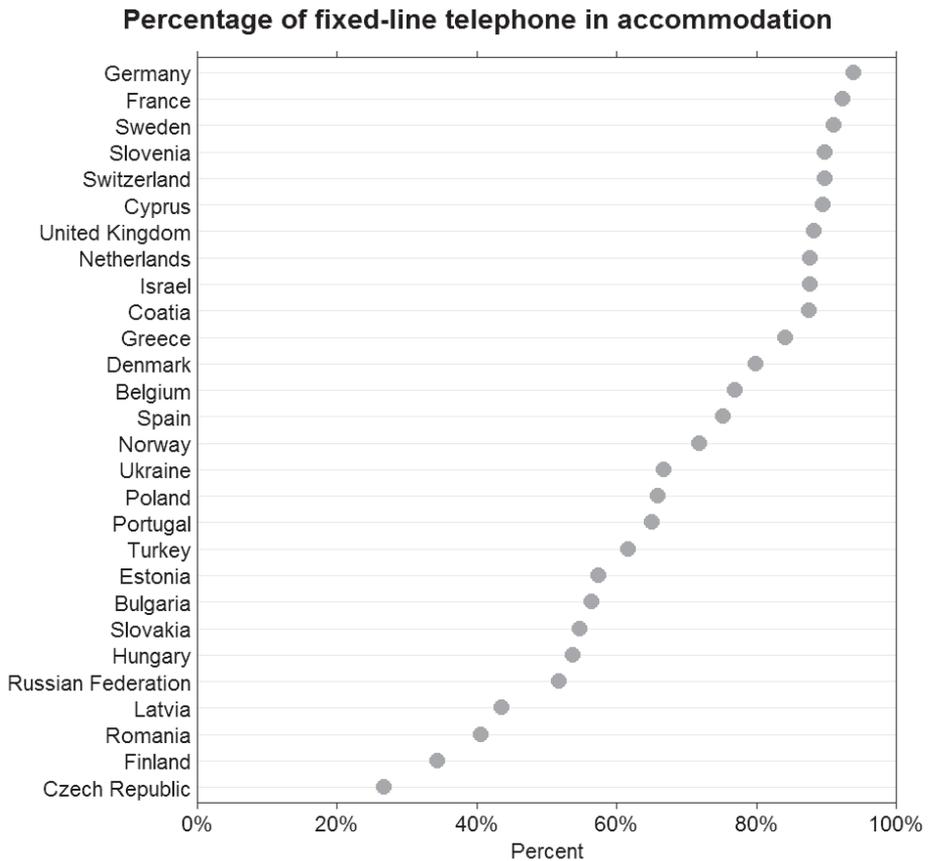
Keeter et al. (2008)

Keeter at al. (2008) state "The decline in the number of young respondents – a casualty of the cell-only phenomenon – is one of the most important problems facing the telephone survey community today" (p. 14). Faced with this challenge the American Association of Public Opinion Research has installed a Cell Phone Task Force that gives guidelines for telephone surveys of respondents reached via mobile phone (AAPOR 2010). But these guidelines show that many research questions still remain unsolved and further research projects are needed.

In Germany there are currently two projects under way that are funded by the German Research Foundation and dealing with mobile phone surveys. One is CELLA - the first phase of this project is documented in detail in Häder/Häder 2009.

Figure 2   Usage of mobile phones in Europe (Source: European Social Survey, round 4, design weighted data)

Percentage of mobile telephone owners
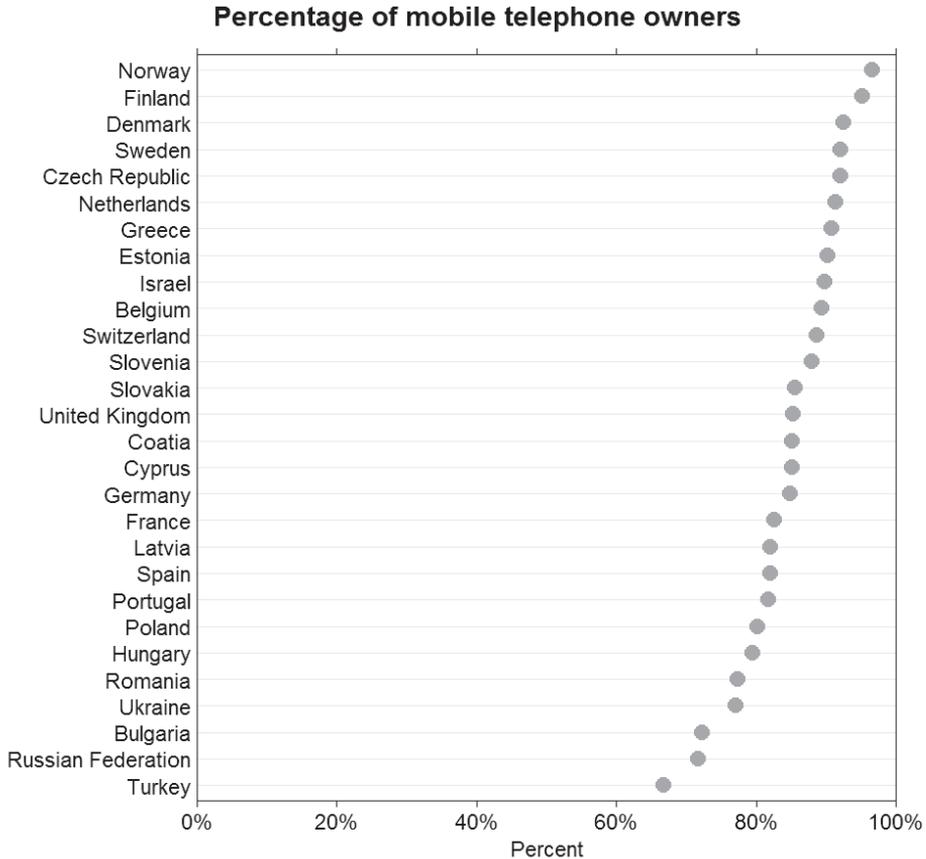
The second is a joint research project of the Technical University of Darmstadt and GESIS. In the following we want to report on this project. Among others the following research questions are in scope of the study:

• How can the mobile phone sampling frame be constructed in a way that the hit-rate, i.e. the proportion of working numbers is satisfying?

• What response behaviour do mobile phone users have?

• How can the information for design weighting (adjustment for differing inclusion probabilities) be provided in an efficient way?

These questions we hoped to answer with the help of an experimental mobile phone panel.

2. FIELD REPORT OF THE PROJECT "MOBILPANEL"

In the first phase of the project the existing sampling frame for mobile phone numbers at GESIS was evaluated. We had developed a new frame that contained a universe of 265.787.000 numbers. If a quantity of 100.000.000 working mobile phones in Germany is assumed this would lead to a hitrate of about 38%. This is even higher than for the frame of landline phones. However, it was hoped to find and cut out blocks of 10.000 or even 100.000 numbers that were obviously empty. In particular, the so-called Gajek list, that contains information on working mobile phone blocks, had to be checked carefully. Furthermore, logical considerations and information from the Federal Network Agency helped to reduce the number of blocks. This way the efficiency of the frame could be increased and the mobile phone frame finally contained only 165.700.000 numbers.

A further question concerning sampling was the design to be applied. Since in mobile phone numbers no regional information is available a stratification referring to this matter is not possible. The only information that could be used for stratification is the prefix of the provider. In our current frame we have 16 different prefixes. However, only if the proportion of non-working numbers is the same in each prefix universe, this stratification leads to an improvement of the quality of the gross sample. This is clearly not the case. Our analyses showed that especially "older" prefixes such as 0171 or 0172 are almost fully occupied with working numbers. Therefore, we decided to order the blocks of 100.000 numbers randomly and to apply a randomized systematic sampling design. For the recruitment of the panel we selected 19.995 mobile phone numbers from the mobile phone frame. From these 16.872 numbers were used for the study.

The questionnaire contained different questions on telecommunication, e.g. on sharing the mobile phone with others, about the quantity of telephone numbers of the household and about internet use. The mean interview length was 13 minutes about the quantity of telephone numbers of the household.

The field time of the recruitment phase lasted from 21st April 2009 to 28th May 2009. In this period we could conduct 725 interviews, 532 respondents were willing to participate in the experimental mobile panel. Since this is a rather low number, that still decreased in the next two rounds (356 in panel round 1, 280 in panel round 2) we will use for our analysis only descriptive statistics. That means our findings are valid only for the panelists and not for the population of Germans aged 18 and over.

The following table gives an overview on the response rate calculation.

Table 2   Disposition codes in the recruitment phase of "Mobilpanel"

Not eligible	
Non-working number: computer voice	6685
Not 18 years old	283
Nonresidence	173
Other	207
Unknown eligibility, non-interview	
Voice mail – don't know if eligible	6789
Eligible, non interview	
Refusal	1765
Break off	13
Physically or mentally unable/incompetent	101
Other	131
Interview	
Complete	725
Total phone numbers used	16872

In order to compute the AAPOR Response Rate 3 we used two methods. In the first case we calculated the proportional allocation method as is (Smith 2009). In the second case we assumed that 100% of the cases of unknown eligibility were in fact not eligible. This gives the following AAPOR response rates:

a)   RR3 (standard e) = 11.0%
b)   RR3 (modified e) = 26.5%

Of course this response rate seems to be very low. But it has to be mentioned that because of time and cost restrictions we could make only 2.5 contact attempts per number and this is not much – actually 10 to 15 contact attempts are advisable. On the other hand almost all respondents had their mobile phone ready to receive at least during the day. Table 3 shows the eligibility of the respondent's mobiles, i.e. the times mobile phones are usually switched on. The fact that in principle at least 95% of the mobiles of our respondents were eligible – since we called them on different days and different times of the day – encouraged us to calculate the response rate b).

Table 3   Frequency of mobile phones that are switched on

	Frequency	Percent
Always, i.e. day and night switched on	522	77.8
Only during the day switched on	96	14.3
Not the whole day switched on	23	3.4
Just more seldom switched on	8	1.2
Not every day switched on	12	1.8
Switched on only if required	10	1.5
	671	100.0
Not valid	54	

3. WHO ARE THE RESPONDENTS OF THE MOBILPANEL?

The following section will briefly describe the underlying sociodemographic characteristics of the respondents. This should give further insights into this relatively new mode of data collection and explain who we have actually reached in this mobile phone survey[2].

In general, more than half (56.4%) of the interviewees are male, which slightly deviates from the German population structure that is more balanced (Statistisches Bundesamt 2008). The mean age of the respondents is about 40 years (minimum 18 years and maximum 83 years) and seems close to the value obtained for the total population (Statistisches Bundesamt 2010), even though only participants starting from the age of 18 took part in the survey (see Table 3-1). This finding indicates that the majority of the participants were of rather young age, which is also shown by the fact that individuals older than 45 years sum up to only one third of all participants (cf. Vehovar et al. 2004).

Table 3-1   Age distribution of the respondents

Age (years)	n	%
18 – 25	169	23.3
26 – 35	146	20.1
36 – 45	158	21.8
46 – 55	125	17.2
56 – 65	73	10.1
> 65	54	7.5
Total	725	100.0

Moreover, we find a nearly balanced level between married and unmarried individuals, whereby an accumulation of married people (>50%) can be observed in the age group from 36–55 years. In contrast to that, three quarters of the singles are between 18 and 35 years. The overall educational level of the participants was surprisingly high, since two-thirds of them owned a higher education entrance qualification. Furthermore, 18.9% had a university degree. A phenomenon frequently observed during landline phone surveys is that the acquired data have a strong bias towards retired persons and homekeepers. In our survey, however, only every eighth respondent was a retiree or homemaker. Thus, our data are likely to contain an adverse bias, since only 10% of our data originate from retired people, which is considerably less than their fraction in the total population (BpB, 2008). This finding is in accordance with the age bias described above and is likely to result from a less frequent occurrence of mobile phones within the elderly population. Furthermore, 50.5% of the interviewed persons were working full time, 13.6% part time and only 5.4% were unemployed – a fact that might suggest a minor bias towards economically actives. This gives rise to the question of whether many respondents stay at work during the survey.

3.1 Locations

Therefore, we focused the attention on the place, where the respondents have been during the interview (table 3.1-1). The analyses point out that over the period of three interviews of the longitudinal survey about two-thirds of the participants were contacted at home via mobile phone, whereas the interviews of the remaining participants (about one-third) took place outside their homes. So, during the first period of interviews there were 37%, at the second 33% and at the third 33% of the participants who were called not in their domestic environment. These findings were also found in the CELLA-study where 62.4% of the respondents were at home during the interview, and 37.6% of the participants were not at home (cf. Schneiderat/Schlinzig 2009).

Table 3.1-1 Findings of the place, where the respondents rest, when they were contacted via mobile phone

	Recruitment		Panel round 1		Panel round 2	
Place	n	%	n	%	n	%
At home	445	63	224	62	203	67
Outside	259	37	138	38	100	33
Total	704	100	362	100	303	100

Regarding just the respondents who were not at home during the interview you can ascertain that a remarkable percentage was at work. Therefore, 45% of the out-of-home-respondents were willing to take part in the interview whilst daily work time. 17% of the out-of-home-respondents were in traffic by car, bus, tram, foot etc., 5% were shopping and 33% allocated on other places. For these analyses we exclusively confined the data of the recruitment, because the sample size of the other both enquiries was too small and so we could not make a significant conclusion.

Overall it should be mentioned that the willingness of being interviewed at workplace is a very interesting result for telephone surveys as the highest percentage of the out-of-home-respondents is listed there. Such a result was also investigated within the CELLA-study (ibid.): 63% of the respondents who were out of their domestic environment have been at work.

Table 3.1-2   Findings of the locations outside (Recruitment)

Out of domestic environment	n	%
At work	116	45%
Traffic (car, bus, tram, by foot)	43	17%
Shopping	14	5%
Other	86	33%
Total	259	100%

Considering the availability of people on their mobile phone when they are at work, one would expect them to be hesitant to participate in the survey immediately, since they may have to give consideration to their role as employee. However, as already shown many people participate in telephone interviews when they are at work. Based on this awareness, it is essential to explore which occupation the respondents pursue.

As table 3.1-3 shows more than half of the out-of-home-respondents who were at work whilst the interview were appointees (63.8%). After that come self-employed persons with 15.5%, workers with 11.2%, others with 7.8% and 1.7% of the respondents gave no statement. This distribution shows that mainly people, who work in offices are willing to participate in surveys. One reason could be that this kind of work environment is more convenient in order to take part in mobile surveys. Opposed to that it is more difficult to participate whilst doing physical activity like workers.

Table 3.1-3   Employment of the respondents who are at work (Recruitment)

Employment	N	%
Worker	13	11.2
Appointees	74	63.8
Self-employed	18	15.5
No statement	2	1.7
Other	9	7.8
Total	116	100.0

Did people who were called during work agree with a further participation in the survey? In fact 66.4% of them were willing to continue, which is, however, 7 percentage points less when compared to the callees that had been reached at other places.

3.2 Estimation of the atmosphere and the importance of surveys for the society

By comparing the perceived atmosphere of the respondents during the initial recruitment phase (rated on a scale from $1 =$ "very unpleasant" to $7 =$ "very pleasant"), we could not observe notable differences between the mean values of those who were reached at work and those who were not at work. Both groups felt a „pleasant" (means: 5.88, 5.96) atmosphere whilst the conversation (see Table 3.2-1).

Table 3.2-1   Perceived atmosphere: A comparison between respondents being at work or elsewhere (Recruitment phase)

Atmosphere	At work ($\varnothing$ 5.88)		Elsewhere ($\varnothing$ 5.96)	
	n	%	n	%
1 – very unpleasant	0	0	1	0.2
2 – unpleasant	2	1.8	9	1.5
3 – rather unpleasant	2	1.7	6	1.0
4 – neutral	7	6.1	38	6.3
5 – rather pleasant	28	24.3	122	20.2
6 – pleasant	34	29.6	197	32.7
7 – very pleasant	42	36.5	230	38.1
Total	115	100.0	603	100.0

Next, we made a comparison of those respondents who rejected to take part in the longitudinal survey (26.6%) and those who approved further questioning. People who refused to participate in the panel stated a lower average perceived atmosphere (5.4 – "rather pleasant"). Contrarily, the respondents who were willing to take part in further rounds of the survey rated the atmosphere of the dialogue better (6.14 – "pleasant"). It is worth pointing out that the overall ratings reached high values in general. This can be explained on basis of phenomena occurring from the "justification of effort" (cf. Festinger 1957, Aronson/ Mills 1959) and the social desirability effect. Moreover, it became apparent that those willing to take part in the survey rather agreed with the statement that "surveys are important for the society", whereas those who were unwilling to participate further remained neutral to the statement.

3.3 Availability

As pointed out before, the individual availability is of crucial importance for telephone surveys. In the present study, almost 12% of the participants had neither a landline nor an equivalent connection (e.g. "homezone") and were thus reachable only by mobile phone. Accordingly, our sample is in agreement with the data shown in Figure 1, where around 90% of all accommodations have a fixed-line telephone in Germany. For a similar survey conducted in Poland we would, however, expect a much higher mobile-only rate. Based on weighted Eurobarometer data, Busse and Fuchs (2010) estimated the mobile-only rate at 32% in the first half of 2008. As well as previously shown in the CELLA-study (Graeske/Kunz 2009), the characteristics 'sex' and 'age' of the mobile-onlys deviate considerably from the ones found in the total population. Thus, mostly men in the age group 18 to 25 own a mobile phone but no fixed line at home. Moreover, it is remarkable that more than half of the respondents in our study that possess an additional landline connection are available for acquaintances exclusively on their mobile phones during 8:00 am to 6:00 pm. In contrast, 12% are available for acquaintances exclusively by landline connection during the same time. Overall, most people that were interviewed during panel round 1 did not name a daytime when they are available best and only 30% preferred to be called during the evening.

In addition, the willingness to answer a call coming from an unknown number is of great importance for telephone surveys. Moreover, in panel round 1, more than half of the people reported that they would always answer a call, independently from the fact that an unknown number is displayed. Nevertheless, one must consider that people who do not take a call if the number is unknown were probably not answering the call in our survey as well. According to this, the random character of our data might be somewhat distorted.

Altogether, our data show that especially in countries with a high proportion of mobile-onlys it is essential that telephone surveys include also mobile phone owners. Otherwise the estimates would be seriously biased because of undercoverage of the landline frame. Furthermore, with mobile phone surveys we are obviously able to reach people who are not at home but willing to participate in surveys, i.e. the accessibility of potential respondents is increased.

In the future a combination of landline and mobile phone samples should become the standard procedure – at least as long as a considerable part of the population still owns a fixed line phone. The procedure to be applied for this is briefly described in the next section.

4. COMBINATION OF LANDLINE AND MOBILE PHONE SAMPLES

AAPOR gives no clear recommendation about how it is advisable to include mobile-onlys in telephone surveys. Three concepts that deal with multiplicities in dual frame approaches are named (AAPOR 2008):

　　a) Linear combinations (composite or "Hartley" weights)

　　b) Computing probabilities of selection to account for overlap

　　c) Raking or post-stratification
　　　　– to totals for usage groups (mobile-onlys etc.)
　　　　– to totals for age and other factors associated with phone usage.

Hartley (1962) was the first who developed a systematic methodology for estimating from multiple frame sample design. He considered the simplest selection procedure, i.e. simple random sampling in each frame. This is of course not applicable to our situation.

In the meantime there have been some more papers published dealing with the multiple frame approach in general and the dual frame approach in telephone surveys (e.g. Lohr 2009, Lohr 2006, Lohr 2000, Brick et al. 2007). Brick and colleagues (2007) mention in a nationwide dual frame survey of landline and mobile phone numbers conducted in 2004: "The study is one of the first rigorous attempts to evaluate the feasibility of surveying cell phone numbers." They mainly compared the results from the two samples. Weighting aspects are considered in Brick and colleagues (2006). However, the design described there is a sample of households – not of individuals. But in most surveys the goal is to estimate characteristics of persons. Thus, selection within the contacted household plays an important role in the computation of weights. In so far the solution of Brick et al. is also not applicable to our situation.

Finally, Gabler and Ayhan (2007) developed an approach for computing probabilities of selection for surveys of individuals to account for overlap. The use

of this model is of course our first preference, since we anyway do not know totals from the population for poststratification weights – as point c) of the AAPOR suggestions advises.

Following Gabler and Ayhan, the inclusion probability of a person i can be calculated as follows:

$$\pi_i \approx \pi_i^F + \pi_i^C \approx k_i^F \frac{m^F}{M^F} \cdot \frac{1}{z_i} + k_i^C \frac{m^C}{M^C}.$$

The relevant parameters are defined as follows (see Gabler and Ayhan 2007):

Figure 3   Overview of the parameters of the dual-frame-model

Landline		Mobile phone	
M^F	frame size of numbers	M^C	frame size of numbers
m^F	sample size of numbers	m^C	sample size of numbers
k_i^F	size of landline numbers allowing access to target person i	k_i^C	size of mobile phone numbers allowing access to target person i
z_i	size of household to which target person i belongs		

For simplifying the formulae they made the following fundamental assumption:

The probability that two (not necessarily distinct) members of the same household are selected into the sample through different ways is negligible.

This assumption could be meaningful only for surveys that are conducted in small regions where the sampling fraction, i.e. the ratio of sample size to population size is considerable. However, this is no real restriction for surveys since mobile phone numbers do not contain regional information and thus it is anyway impossible to plan small regional surveys via mobile phones in Germany.

Now it has to be explained how the information for the calculation of the weights has to be collected.

In figure 3 it has been mentioned that M^F is the quantity of landline phone numbers in the frame. Currently in the German landline phone frame $M^F =$ 140.331.400 (July 2009). m^F is the quantity of landline phone numbers in the sample (the gross sample size).

M^C denotes the quantity of mobile phone numbers in the frame. As mentioned earlier at present we have M^C= 180.000.000 in Germany. m^C is the quantity of mobile phone numbers in the sample.

Now we have to determine k_i^C, the quantity of mobile phone numbers allowing access to person i. Firstly, we can assume that mobile phones are used in almost all cases as personal equipment. That is of interest because otherwise we would have to select one person out of those persons who usually use the mobile phone together. But only a minority of mobile phone users in Germany obviously shares it with other persons. In the recruitment phase of the Mobilpanel project we asked if they personally own a mobile phone. 94.3% of the respondents answered with "yes".

We also asked on how many mobile phone numbers the target person is reachable. The answers are shown in table 4.

Table 4   Quantity of mobile phone numbers

	Mobile phone sample	
	n	%
One	549	80.3
Two	61	8.9
Three	54	7.9
Four	11	1.6
Five and more	8	1.3
Don't know/ no answer	1	-
Total	590	100

These values could be used as variable in the dual frame model. Furthermore, the quantity of landline phone numbers – allowing access to the household to which person i belongs – has to be fixed. The difficulty is that people often do not know exactly how many landline phone numbers they have (Meier 2007). In Germany we have found a rule of thumb which is reasonable for telephone equipment: We fix that an analogous telephone connection has one working number while a digital connection has 2.5 working numbers.

Because for the landline sample the respondent was selected with the modified birthday method, the inclusion probabilities for the household members vary. They depend on z_i, the size of the household (belonging to the target population) to which person i belongs. This information has to be asked in the interview.

Using this model and including the corresponding weights in the estimation clearly leads to less biased estimates (Graeske/ Kunz 2009; Callegaro et al. 2010) than those from separate samples would do. In so far the dual frame approach – combining one sample where interviews were conducted via mobile phone with another sample where interviews were conducted via landline phone – currently seems to be the best practice for telephone surveys.

NOTES

1 ADM – Arbeitskreis Deutscher Markt- und Sozialforschungsinstitute e.V. is a business association which represents the interests of private-sector market and social research agencies in Germany. ADM members account for more than 80% of industry turnover. ADM is the only association of this kind in Germany.
2 It has to be stated again that we calculated our analysis with unweighted data because of the small sample sizes. For inference a design weight containing the inverse of the inclusion probabilities should be applied. Differences in inclusion probabilities result from the varying number of mobile phone numbers that respondents have.

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