

**WHERE CAN I CALL YOU?
THE “MOBILE (PHONE) REVOLUTION” AND ITS IMPACT ON SURVEY
RESEARCH AND COVERAGE ERROR: A DISCUSSION OF THE ITALIAN CASE**

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The increase in mobile phone ownership is changing the sampling frame for landline telephone surveys, with a consequent impact on coverage error. This paper describes the main features of the Italian phone market – characterized by high mobile phone penetration rates – and the rising impact of mobile-phone-only (MPO) households. A survey that uses a landline sampling frame excludes MPO and no-phone households, creating a noncoverage rate of 17% in 2002. Types of phone arrangements and noncoverage vary dramatically among households: by region, household type, age, education and social class of the household. All these differences clearly introduce a non-ignorable bias in landline telephone surveys. Possible solutions are discussed from a methodological perspective. The analysis presented uses data collected in a face-to-face survey by the Italian Institute of Statistics.

Key words: Telephone survey methodology, mobile (cellular) phone surveys, mobile-phone-only households (MPO), noncoverage rate, Italian Multipurpose Household Survey.

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1. INTRODUCTION

As in other countries, phone surveys are widely used in Italian market and public opinion research and in social and economic enquiries (Chiaro, 1996). Compared to the traditional face-to-face approach, telephone interviewing allows the data collector to save time and money and has further advantages: better control of the quality of the interview through a centralized facility, monitoring and supervision, and the opportunity to include experiment-like variables in the survey (Groves et al., 1988; Piazza & Sniderman, 1998). Sampling designs adopted in phone surveys are, at least in principle, similar to those used in face-to-face surveys. Simple random samples, stratification and clustering can be achieved with random digit dialing (RDD). When the percentage of households not listed in phone directories is very low, as in Finland (Kuusela, 2003), phone directories can be directly used as sampling populations from which to draw the frame, increasing the efficiency and timeliness of data collection. Specific methodological problems arising from telephone surveys can generally be handled using weighting to account for different selection probabilities and introducing random criteria for individual selection within the contacted household, such as the nearest birthday methods or the Kish grid (Lavrakas, 1993).

Phone surveys are based on the implicit assumption that their sampling frame can provide reasonable coverage of the target population. This condition can be satisfied by (a) guaranteeing full coverage of the target population, or through (b) redefining the target population to correspond to the sampling frame of the phone survey, or (c) controlling in some way for potential bias introduced by a sub-optimal coverage rate.

In the past, when not all Italian households had a landline connection, it was obviously impossible to assure full sampling coverage of Italian households in phone surveys. However, households not covered by the phone sampling frame could either be considered not in the target population – as, for instance, in market research there would be little interest in low-income elderly people living in the South of Italy (the traditional bulk of no-telephone households in this country) – or be accounted for by some weighting procedure when their characteristics are known and relatively stable over time, as was the case during the 1990's.

Over the last few years, the rapid and pervasive diffusion of mobile phones within Italian society has led to noticeable changes in households' telephone arrangements, with a steady increase in household ownership of at least one mobile phone, but with no landline connection: according to recent estimates, 13.1% of all household units are mobile-phone-only households (Istat, 2003b).

These rapid changes have important consequences for telephone surveys of the Italian public: (1) a reduction in the coverage rate of landline telephone sampling frames and (2) an increased complexity in the social composition of households not covered by these frames; (3) a rapid change in the coverage rate and, possibly, in the social composition of the household not considered in the landline sampling frame. These three factors are likely to affect the quality of landline telephone surveys by affecting estimates for a greater number of social strata than in the past, and by limiting the amount of available information for effective weighting procedures.

We can consider four types of phone arrangements: (1) no-phone households, (2) landline-phone-only households, (3) households with landline and mobile phones, and (4) households with mobile phones only (MPO). As we illustrate below, phone arrangements tend to vary by socioeconomic characteristics and geographic location of the household. Studying how these arrangements are distributed among social strata, may contribute to assessing the impact of noncoverage in landline surveys and evaluating the reliability of alternative sampling frames, e.g. a mobile phone sampling frame.

In this paper, we study the relationships between the types of phone arrangements and noncoverage rate in phone surveys. In particular, we address two research questions:

- To what extent is the rapid and pervasive diffusion of mobile phones undermining the quality of phone surveys by increasing noncoverage?
- How do phone arrangements of Italian households vary across social strata? In other words, which of the social strata are more likely to be affected by noncoverage?

In the first part of the paper, after introducing the problem of coverage error, an overview is provided describing the main features of the Italian telephone market and social aspects of mobile phone usage. We then describe the data and methods used in our study and present our findings. We end with a discussion of the possible solutions that may be implemented and with tentative conclusions that we have drawn from these findings.

2. STATEMENT OF THE PROBLEM

Coverage error is a nonsampling error of nonobservation due to the fact that a part of the target population is missing from the frame the sample is drawn from (Groves, 1989). In a descriptive case, the coverage error of a statistic is a function of two factors: the proportion of the target population that is not in the sampling frame, and the difference in the values of the statistic for those in the frame vs. those not in the frame. These relationships can be expressed through Equation 1.

$$Y_c = Y + \frac{N_{nc}}{N}(Y_c - Y_{nc}) \quad (\text{Equation 1})$$

where Y_c is the value of the statistic for those covered by the sampling frame, Y is the value of the statistic for the whole target population, N_{nc} is the number in the target population not covered by the frame, N is the total size of the target population, and Y_{nc} is the value of the statistic for those not covered by the frame.

It is relevant to point out that in order to get better estimates, researchers can only try to control the first factor, noncoverage, while no control is allowed for the second factor, the difference in the values of the statistic for those in the frame versus those not in the frame.

We used data from the face-to-face Multipurpose Households Survey collected by the National Institute of Statistics (ISTAT) to estimate the effects of potential coverage error due to a landline telephone sampling frame. Some descriptive statistics related to various conditions, behaviors and opinions of Italian households are shown in Table 1. We calculated these estimates separately: (1) for all households without landline phone connection, (2) for all the household units with a landline telephone and (3) for the whole sample. Our coverage error estimate is the difference between the estimates from the sample of households with a landline connection and estimates from the full sample². Differences in percentage points between estimates from these two samples range from -0.2, in the case of the “households who declared their financial situation has declined, compared to the previous year”, to 3.9 for the

² Other possible sources of error in survey research are not considered for simplicity reasons.

home ownership rate. The observed differences clearly indicate to what extent coverage error may affect telephone survey results.

For example, a noncoverage rate of about 14% and a difference between the two sub-populations of about 25 percentage points in their home ownership rate turn out in a 4 percentage points coverage error, affecting the corresponding estimate from an hypothetical landline sampling frame.

Table 1. Selected descriptive statistics for households with and without a landline telephone and for all households

	(1) Households with no landline telephone (14.5%)	(2) Households with a landline telephone (85.5%)	(3) Total (100%)	(4) Coverage error (% points) (2) – (3)
Percentage of households owning their home	51.7 %	75.7 %	72.2 %	+ 3.5
Percentage of households owning a personal computer	17.5 %	38.3 %	35.3 %	+ 3.0
Percentage of households who always separate paper from household waste	35.6 %	56.3 %	53.3 %	+ 3.0
Percentage of households who declared that their financial situa- tion has declined, compared to the previous year	22.2 %	20.2 %	20.4 %	- 0.2

Source: Multipurpose Household Survey, 2001 (N=19,742)

3. STRUCTURE OF THE TELEPHONE MARKET AND SOCIAL ASPECTS OF PHONE USE IN ITALY

Italy's communication network is characterized by the presence of one major national landline telephone company, Telecom Italia, and by four mobile phone companies³: three GSM carriers – TIM, Vodafone Italia, and Wind⁴ – and one UMTS company, Tre.

Telecom Italia, formerly SIP, was owned by the State that managed the network as a monopolistic system. In 1994 Telecom Italia was privatized and is now made up of several companies – one of them is the mobile phone company TIM. In 1998 the market opened to other landline “long distance” phone companies, but Telecom Italia still owns the right to assign the line, i.e. in order to have a phone line the customer must have a contract with Telecom Italia⁵. This “limping deregulation” (Pontarollo & Frova, 2004) does not ensure true competition in the Italian telecommunications market since Telecom Italia is still in a position close to monopoly. The current cost for a new installation with Telecom Italia (a phone

³ The information on the Italian telephone companies is taken from the companies' websites.

⁴ Vodafone and TIM have just started their UMTS service.

⁵ The only exception is to subscribe a contract with Fastweb, a company that uses fiber optics, but the coverage of Fastweb is limited to some northwestern cities and other cities of Italy.

number assigned) is 150 Euro, while the monthly fee is 14.57 Euro. The cost to move the line to a new location is 72 Euro.

TIM was the first cellular phone company and started its service in 1990 with the analog service TACS; followed by Omnitel in 1995, now Vodafone Italia; and lastly by Wind in 1997. Tre is a UMTS company, which started its service at the end of 2002. TIM had 26.1 million active SIM cards at the end of 2003. Vodafone had 21.13 million active SIM cards at the end of March 2004; 92% of which were prepaid. Wind has 10 million active SIM cards, while Tre reached 1 million clients last April 2004⁶.

The rate of diffusion of mobile phones in Italy is one of the highest in Europe and in the world with one SIM card per country resident⁷ (International Telecommunication Union, 2003). The reason is the phenomenon of multiple SIM cards ownership. In 2001, the percentage of Italian mobile phone subscribers with more than one phone number (SIM card) was 13% (Ofitel, 2001) and was estimated between 20 and 25% in 2002 (Costabile & Addis, 2002a). Mobile phone number portability, which became available in March 2002 (Electronic Communications Committee (ECC), 2003) did not contribute much to the reduction of multiple SIM cards, partially due to the aggressive marketing campaigns of the mobile companies that, in a saturated market, tried to “steal” clients from other companies offering SIM cards with special features and competitive rates (Costabile & Addis, 2002b).

In order to have a better measure of mobile phone ownership, without double or triple counting of SIM cards, we can use household survey data. At this level, the percentage of the Italian households who own a mobile phone is 75.4% (ISTAT, 2003a). The explosion in mobile phone ownership coincided with the introduction of prepaid contracts in 1996 and with high competition among the three GSM companies. Another factor was a very high cost of calling a mobile phone from a landline: from 75 Eurocents to 1 Euro per minute during peak hours in the early 1990's. These high prices forced even the most “cellular phone resistant” customers into getting a mobile phone so that they call their friends and family, as mobile-to-mobile calls are generally cheaper, especially on the same carrier's network. In Italy, unlike the U.S., mobile phone users do not pay to receive a phone call⁸ because the cost is charged entirely to the caller. Mobile phone numbers are easily identified with special three digits prefixes.

The rapid increase in mobile phone ownership changed the market for landline phones; many people gave up their contracts to become mobile-phone-only users, or chose not to install a landline when moving to a new place. One reason that many people keep a landline phone is the need for an internet connection, since in Italy the only way to connect is through a phone line, either dial-up or ADSL. No cable service, a valuable alternative to internet connection, is in fact available, unlike other countries, such as the U.S., Belgium or the Netherlands.

Social reasons for the high success of mobile phone in Italy are investigated by (Fortunati, 2002). Using different survey datasets, the author identified three main reasons. The first is due to the way the mobile phone was introduced in Italy, as a simple, easy-to-use-gadget. Contrary to some stereotypes, Italians showed to be technophobe and admitted having difficulties with new technologies. The second reason lays in the fashionable aspects of a

⁶ TACS (Total Access Communication System) denotes one of the first analog technology for mobile phones. GSM (Global System for Mobile communication) is the world's most widely used digital network. UMTS (Universal Mobile Telecommunication System) is the new generation of digital network capable of a sending and receiving a higher amount of data. It can support a wide range of voice, data and multimedia services. SIM card is the Subscriber Identification Mobile card. A small printed circuit board that must be inserted in any GSM-based mobile phone when signing on as a subscriber. It contains subscriber details, security information and memory for a personal directory of numbers.

⁷ The current estimate is 57.3 million of inhabitants (ISTAT, 2004).

⁸ Unless he/she is abroad. In that case roaming charges are applied for both receiving and calling.

mobile phone, seen as an accessory that enriches those who wear it (Alberoni, 1998). A third and strong reason contributing to the great success of mobile phones is that they are useful for re-productive work⁹. Examples of re-productive work include work for the household and managing the entire social network among friends and relatives. Italian people, more so than respondents in Spain, Germany, France, and the UK, report using a mobile phone to manage time and get information, regarding it as a facilitator of social relations. Moreover, Italians respondents – similar to French – stated that they personally, rather than their employers, subscribed to receive mobile phone service. The reason for this choice was primarily to support activities connected with private and everyday life. The mobile phone also is used to maintain connections with the family, which is very important in the Italian culture.

To summarize, the observed outcome of an extensive penetration of mobile phones in Italy appears to be due to both economic and cultural factors: it is cheaper to have a mobile phone than a regular landline and it is cheaper to call a mobile phone from other mobile phones. There is no need for a permanent contract and prepaid mobile phones are in fact the most popular contracts, even in the business world. Finally, the competition between mobile phone and landline companies further increased the mobile phone ownership rate. Given the economic considerations, the mobile phone fitted perfectly in the Italian culture oriented toward maintaining social relations, especially at the household level. Fashionable aspects and ease of usage were also important selling points that contributed to the fast diffusion of the device.

4. COVERAGE RATES OF PHONE SURVEYS IN ITALY AND OTHER COUNTRIES

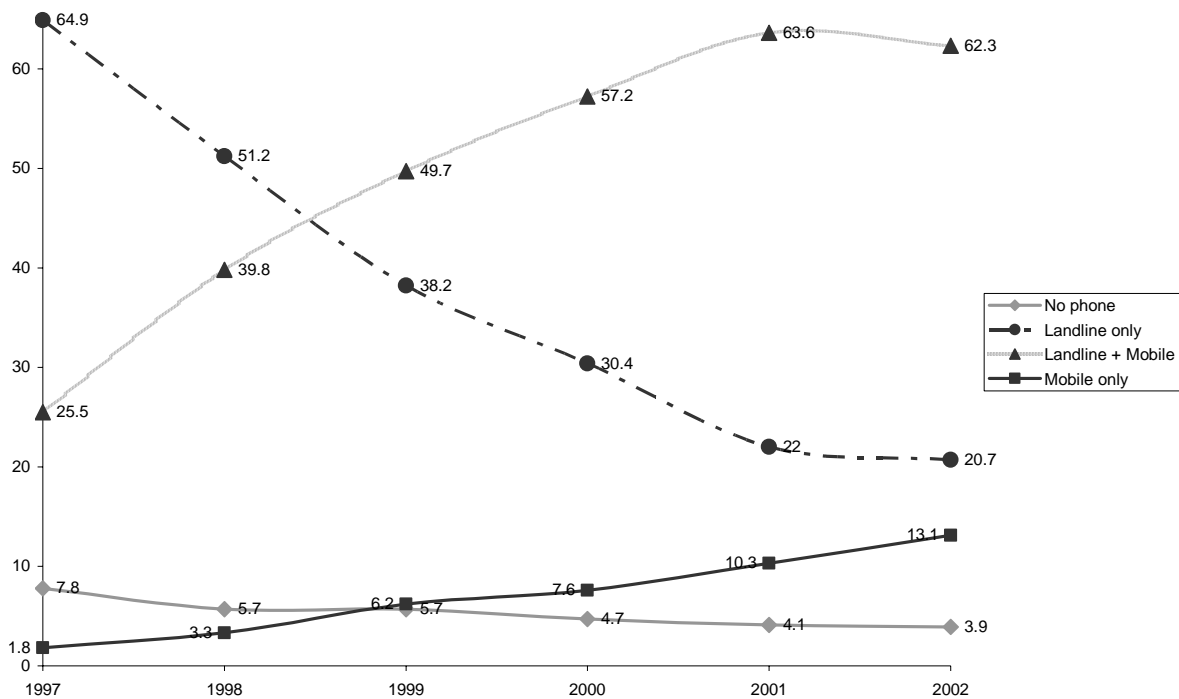
4.1 Ownership trends for landline and mobile phones in Italy

Figure 1 shows the trends of substitution of a fixed phone with a mobile phone by Italian households over the period 1997-2002 (ISTAT, 2003c).

The graph shows the rapid decline of households with a fixed phone only, dropping from 64.9% to 20.7% in only 5 years. At the same time, a small decline in no-phone households is observed, however they are still a non-ignorable part of the Italian population.

⁹ Re-productive work is all the work that is unpaid and that takes place in the sphere of social reproduction (friends, family, free time...). It serves to rebuild and to recreate the energy consumed in the workplace. The main subject in this process is the woman, but all individuals contribute to it. The definition here is broader than the original use of reproductive work as a synonym of domestic labor.

Figure 1. Italian households phone coverage during 1997-2002 period



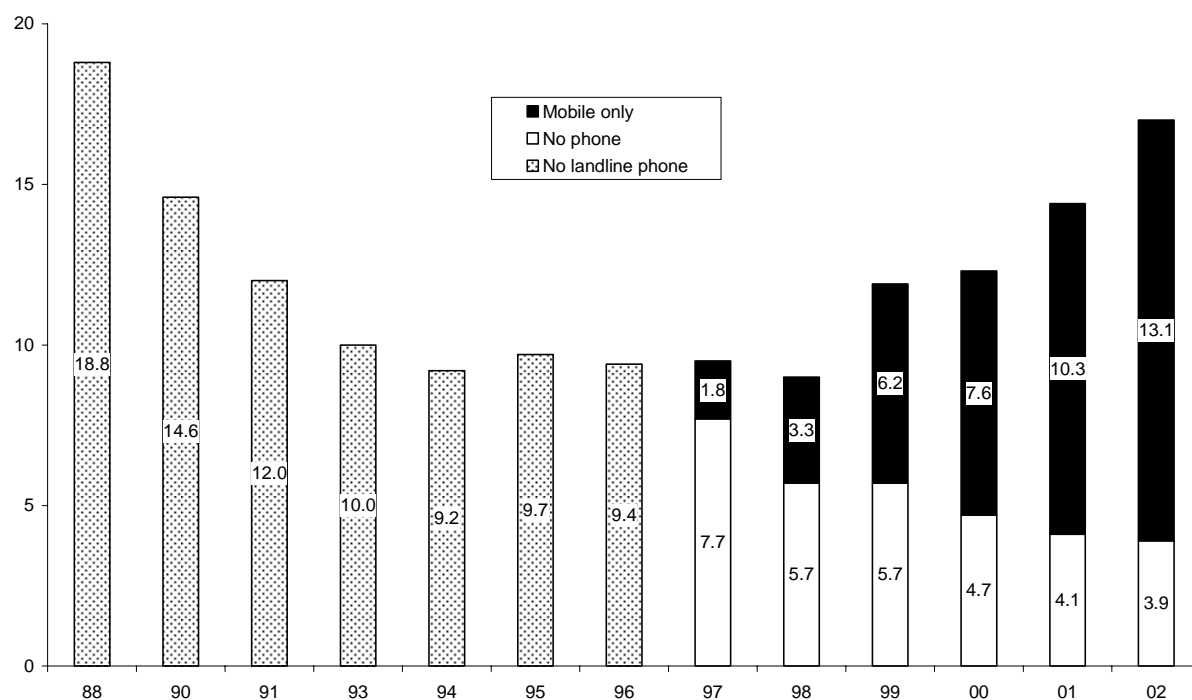
Source: (ISTAT, 2003c, p. 5)

We see a steady increase in mobile-phone-only households: they doubled their share during the first years reaching 13.1% in 2002. While households with both landline and mobile phone(s) increased rapidly in the late 1990's, their number seems to stabilize, if not to decline, in the years 2001 and 2002, settling at 62%.

When using traditional fixed phone frames, either RDD or list-assisted (phone directory), the noncoverage rate is a consequence of two components: households with no phone plus households with only mobile phones.

Figure 2 shows the noncoverage rate of the phone sampling frame for the period 1988-2002. Since 1997, information is also available on mobile phone ownership. It was then possible to study noncoverage composition, distinguishing between mobile phone only households and households with no phone at all.

Figure 2. Noncoverage rate in Italy during the 1997-2002 period



Source: Authors' calculation from Istat Multipurpose Household Survey, various years and from the 1991 General Census.

We can see that until the middle of the 90's noncoverage was steadily decreasing and that during the last decade, when telephone survey became a very popular strategy of data collection in Italy, its rate was largely below 10%. From the late 90's on, the noncoverage rate started increasing, mainly due to mobile phone only households.

In 1997, the noncoverage rate due to mobile-phone-only households was modest, just 1.8%. Noncoverage was mainly due to household with no phone at all, for a total of 9.5%. The lowest noncoverage rate was estimated for 1998 at 9%. From 1999 on, households without phones started to decline settling at 3.9%, but mobile-phone-only households increased rapidly, resulting in a total noncoverage rate of 11.9% in 1999, 12.3% in 2000, 14.4% in 2001, and 17% in 2002.

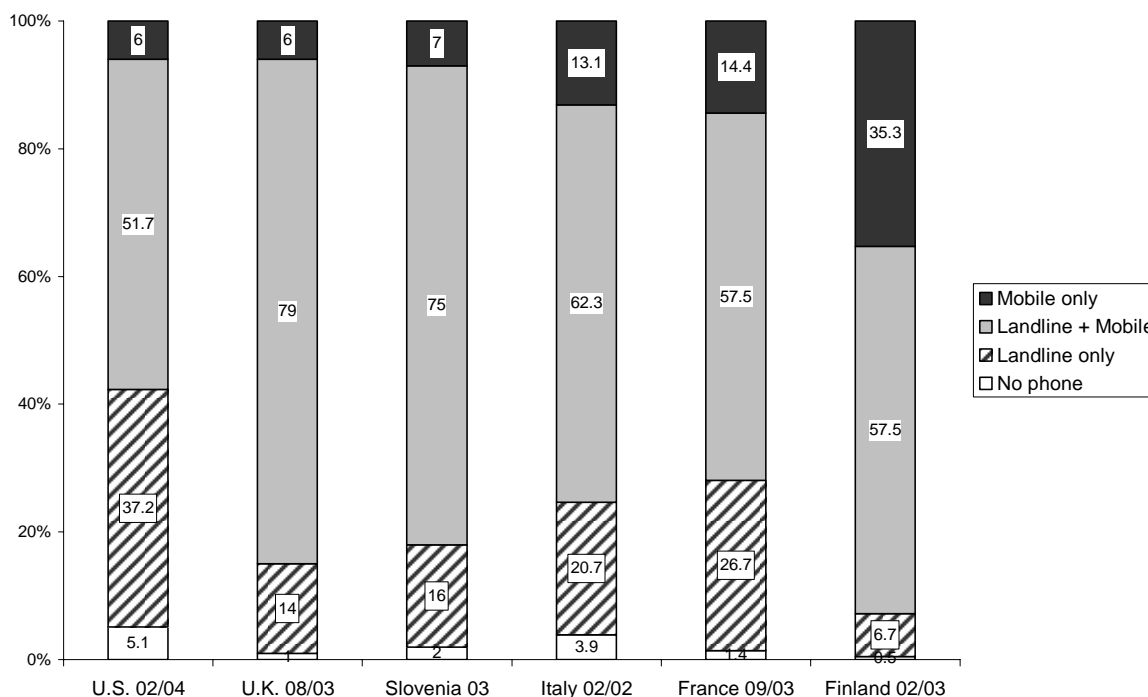
4.2 International comparisons

Comparison of the Italian case with other countries is presented in Figure 3 using data from nationwide face-to-face surveys, the only way to correctly measure all four types of households. To our knowledge, the figures are the most recent that are available, but as they do not represent the same years, care is required when comparisons are made.

The Italian pattern is most similar to the French one, with a high percentage of mobile-phone-only households. The UK and Slovenia have a comparable distribution of phone arrangements, with a lower noncoverage due to MPO. The share of MPO households in the UK has been relatively stable over the last three years. Changes were mainly in the reduction of landline households (from 33% in 2000 to 14% in 2003) and an increase in households with both types of phones (from 60% in 2000 to 79% in 2003) (Ofcom, 2003); see also (Taylor, 2003). Finland is a historical outlier, with one of the highest percentages of mobile-phone-only households. In the U.S., the phenomenon of mobile phones was recently measured with

a Current Population Survey supplement in February 2002. The mobile phone system in the U.S. works very differently than in Europe and it was fully described elsewhere (Buskirk & Callegaro, 2002; Robbins & Turner, 2002).

Figure 3. Phone coverage in selected countries



Source: (ISTAT, 2003c; Kuusela, 2003; Médiamétrie, 2003; Oftel, 2003; C. Tucker, Meekins, Brick, & Morgenstein, 2004; Vehovar, Lozar Manfreda, Koren, & Dolnicar, 2004)

5. DATA AND METHODS

5.1 Data

Our research is based on a cross-sectional analysis of data from the Multipurpose Household Survey for 2001 (ISTAT, 2003b)¹⁰. This survey has been conducted annually by the National Institute of Statistics (ISTAT) since 1988. It is a nationwide face-to-face survey with a sample size of approximately 20,000 households. A two-stage sampling design is applied: municipalities are the primary sample units, while households are selected at the secondary level. Within the households, all individuals are interviewed directly or via a proxy respondent within the household. Data are collected on both the ownership of landline telephones and, since 1997, on the ownership of mobile phones within the interviewed households, allowing an assessment of the coverage rate of phone sampling frames and of possible coverage error in statistical estimates.

¹⁰ While in previous sections we were able to use aggregated figures from the Multipurpose Households Survey for 2002 published in Istat reports, micro data for secondary analysis from this survey has not been released until mid July 2004. A study based on the 2002 data could not meet the conference deadline.

In 2001, 19,920 households (53,113 individuals) were interviewed. From that sample we had to drop 254 cases because of missing information on variables relating to the occurrence of landline and/or mobile telephones. Additional missing values for social class and the housing tenure variables have been considered in the analysis for control purposes.

The data presented a few problems for our purposes. First, as the survey was not focused on telephone usage, only limited information was collected on it and on other related variables. Nevertheless, available information on ownership of landline and mobile phones allowed us to address our main questions.

A second problem arose because information about two relevant variables related to telephone usage was unavailable. Due to privacy reasons, we could not control for the respondents' community size, an indicator of both the relative cost of managing every day life and re-productive work without phone connections, and the relative importance of traditional forms of communication in social life. In the 2001 survey, data were also not collected on the proximity of close relatives who are not living in the interviewed household: if these relatives live in another region a telephone connection might be necessary to communicate with them; on the other hand, living in the same building with close relatives may explain why some people chose not to own a phone: their personal social life can be more easily managed face-to-face and they probably can also use their relatives' telephone line when they need to.

Despite these problems, the Multipurpose Household Survey offered a generally reliable picture of the relationship between phone arrangements and a number of social stratification variables.

5.2 Models and variables

We started our analysis with a binomial logistic regression model for the probability of not having a landline connection, i.e. exclusion from a possible landline sampling frame. This model allows us to investigate within a multivariate framework whether, and to what extent, noncoverage in a landline phone sampling frame can create a bias.

Then we specified a simultaneous bivariate probit model (Ashford & Sowden, 1970; Greene, 2003, p.714-719; Weeks & Orme, 1999) for both the probability of not having a landline connection and the probability of not owning a mobile phone. The advantage of the latter model is that it allows us to investigate the probability of the four types of phone arrangements in different social strata, and to test if ownership of a landline phone is independent of ownership of a mobile phone and vice versa.

Our two dependent variables were derived from the original variables measuring the ownership of a landline phone and/ or mobile phones within the interviewed households¹¹. A set of independent variables, dealing with typical patterns of social stratification in contemporary societies has been considered. Two variables *age of the reference person within the household*¹² and *type of household composition* account for the household's stage in the course of their life. The former distinguishes twelve age intervals derived from the continuous age variable in order to tackle the problem of observed nonlinearity. According to previous studies (ISTAT, 2003c), mobile-phone-only households are more common among the youngest age groups while the elderly are more likely than others to live without any telephone connection. We expect households in the middle age intervals to be more likely to be connected through landlines.

¹¹ Question wording: Does the dwelling have a telephone? (Yes – No); The household owns mobile phones (Yes – No). Italian version: L'abitazione dispone di telefono? (Sì - No); La famiglia possiede telefoni cellulari (Sì - No)

¹² Within couples, the male partner is the reference person.

The *household type* variable classifies: (a) singles; (b) couples without children; (c) couples with children; (d) single parents; (e) multi-family households and cohabitations¹³. According to our “re-productive work” hypothesis, a greater complexity of households life implies more needs for coordination and hence for more telephone connections. Couples living with children and complex households are expected to be better connected than other types of households. Since younger people are more involved in the “mobile phone revolution”, we expected that not only the younger households but also the ones in which younger people live (couples with children, single parent families) are more likely to have a mobile phone.

The socioeconomic position of a household was assessed through the *highest educational level* and *social class* variable. These variables are related both to the reference person (RP) within the household and to his partner, if there is one. The education variable classifies the highest educational level attained by the RP and his possible partner with: (a) a university degree or higher; (b) secondary education (4-5 years of school after compulsory level); (c) vocational training (2-3 years of school after compulsory level); (d) lower secondary education; (e) primary education; (f) no formal education. We expected the more educated households to be more likely to live in a dwelling with a landline connection, as it is generally a prerequisite for Internet connection (internet use is correlated with education).

The *social class variable* classifies households by the prevailing occupation between the RP and his possible partner ones. The variable classifies households headed by: (a) service-class workers (people in higher level non-manual occupations or in liberal professions, such as lawyers, architects, etc.); (b) middle-class workers; (c) urban self-employed workers (including large employers); (d) farmers; (e) blue-collar workers (the urban working class); (e) agricultural laborers. A residual modality has been considered for household units with missing information on their social class, mainly for control purposes. The social class variable has been derived by recoding available information on last known occupation according to the class schema by Erikson and Goldthorpe (Erikson & Goldthorpe, 1992), which is used even if there is only partial information. Since all of the considered phone arrangements are not dramatically expensive, we treated the class variable mainly as related to differences in lifestyle and patterns of consumption (for example, the internet) and only to a limited extent as an indicator of the household’s resources. Service-class and middle-class households are expected to be more connected than households in other classes.

Finally, we defined three variables largely as controls. We have classified respondents' *geographic region* using the ISTAT scheme, distinguishing among four macro-regions: (a) Northwest; (b) Northeast; (c) Centre; (d) South and Islands. It is widely acknowledged that in southern Italian regions and in the Islands both MPO and no-phone households are more common.

The *housing tenure* variable was then derived distinguishing among households that (a) own their homes; (b) live in rented dwellings; (c) live in dwellings in other tenures (mostly with no rent charged); (d) a residual modality has been considered for household units with missing information on this variable, mainly for control purposes. We expected households who own their home to be more interested in equipping their dwelling with a landline connection. The *number of individuals working* in the household has been used as a rough proxy for coordination needs in re-productive work, distinguishing among (a) households with nobody working, (b) with one person working and (c) with two or more people working. We expected that the more people are involved in working activities – that generally take place outside home – the more likely is the household to own a mobile phone.

¹³ Children considered in our “couple with children” and “single parent” categories also include grown-up children still (or again) living with their parents.

Descriptive statistics for the independent variables are presented in Table A1 of the Appendix. References to the ISCED classification (OECD, 1999; Unesco, 1997) for the *educational level variable* are also presented. A more detailed appendix on the rules applied to selecting a reference person/couple and to deriving the variables used in this study is available from the authors on request. It is important to point out that household data were transformed according to homogenization rules and hence they may not exactly match disaggregated data, from the same data set, published by ISTAT. Descriptive bivariate statistics on the distribution of the four types of phone arrangements by the independent variables are presented in Table A2 of the Appendix.

6. RESULTS

6.1 Landline Telephone Frame Noncoverage Rate Among Italian Households

Estimates from a binomial logistic model on the probability of having no landline connection, and hence of being excluded from a landline phone sampling frame, are presented in Table 2. The odds ratios also reported in the table provide a more easily interpretable metric than the logit coefficients.

The probability of not having a landline connection varies by geographic region and social stratum. Households living in the South and on the islands are more likely to be without a connection: their odds of being noncovered by a landline sampling frame are about three times greater than the same odds for households living in the Northeast and more than twice the same odds for households living in the other two regions. Main differences come however from the household's position in the course of their life: being among the youngest households (the RP is between 16-30 years) makes the odds of doing without a landline phone more than 7 times greater than being in our baseline group (51-55 years), holding all other variables constant. Even if the pattern is not fully linear, the odds of living in a dwelling without a landline connection clearly decrease when age increases. The form of household composition also matters: as expected, couples with children are more likely to have a landline connection: in the odds metric, for every household without a fixed phone in this category, we estimate four single-households (odds ratio= 4.39:1) and two single-parent-households in the same condition (2.01:1), holding all other variables constant.

The likelihood of having a landline connection rises with the level of education: when compared with our reference category – lower secondary education, that was the Italian compulsory level until a few years ago – the odds of not having a fixed phone connection are halved for the households with the highest level of education. At the opposite end, odds of not having a landline phone for households in our “no formal education” category are more than twice the ones for our reference category.

Eventually, social class is also directly relevant to the probability of not having a landline connection: household units of service-class and middle-class workers have lower odds of not having a fixed phone than households of blue-collar workers. Conversely, households of agricultural laborers have higher odds than the latter for the same outcome.

Finally, housing tenure also matters, as the odds of not having a fixed phone for households who rent their dwelling are more than twice the same odds for homeowners, holding all other variables constant. This finding is likely to account for a “substitution effect”: mobile phones are likely to replace the landlines when households are committed to invest in their home only to a limited extent.

6.2 The overall phone arrangements of Italian households

Our interest was also in investigating the joint probability of the four phone arrangements in order to gain further knowledge about the noncoverage rate, its internal composition and reliability of possible new phone sampling frames.

Table 3 provides estimates from a simultaneous bivariate probit model for the probability of having no landline connection and not having a mobile phone, together with the corresponding single equation probit models. In the bivariate model, the estimate of the ρ -coefficient itself is around zero (- 0.0399) and the likelihood ratio test (not shown) for this coefficient failed to reject the hypothesis $\rho=0$. The ρ -coefficient measures the correlation between disturbances in the two equations, due to omitted factors (Greene, 2003, p. 717). A ρ -value of 0 means that it is reasonable to assume no correlation between the two outcomes, after taking into account the influence of the variables in the model. Substantially, we can see the two outcomes as a result of two “distinct choices” which are accounted for by the two single-equation probit models, which in fact produces parameter estimates identical to the bivariate model. For these reasons, from now on we will only discuss the two single equation probit models.

Table 2. Estimates of a binomial logistic model for the probability of having no land-line telephone connection

	Parameter	Standard error	Odds ratio
<i>Age group – RP (ref. : 51-55 years)</i>			
16-30 years	2.03**	(0.12)	7.65
31-35 years	1.58**	(0.11)	4.86
36-40 years	0.94**	(0.11)	2.57
41-45 years	0.70**	(0.11)	2.02
46-50 years	0.47**	(0.11)	1.60
56-60 years	-0.27 *	(0.13)	0.76
61-65 years	-0.60**	(0.13)	0.55
65-70 years	-0.60**	(0.13)	0.55
71-75 years	-0.74**	(0.13)	0.48
76-80 years	-0.93**	(0.14)	0.39
81 years or more	-0.53**	(0.14)	0.59
<i>Household composition type (ref. : couples with children)</i>			
Singles	1.48**	(0.06)	4.39
Couples without children	0.51**	(0.07)	1.67
Single parents	0.70**	(0.09)	2.01
Multifamily households and other cohabitations	0.22 *	(0.10)	1.25
<i>Household educational level (ref.: lower secondary educ.)</i>			
Higher/university education	-0.87**	(0.11)	0.42
Secondary education	-0.35**	(0.07)	0.71
Vocational training	-0.34**	(0.11)	0.71
Primary education	0.26**	(0.08)	1.30
No formal education	0.91**	(0.10)	2.48
<i>Household social class (ref: blue-collar workers)</i>			
Service-class workers	-0.46**	(0.10)	0.63
Middle-class workers	-0.39**	(0.08)	0.68
Urban self-employed workers	-0.26**	(0.07)	0.77
Farmers	0.17	(0.10)	1.19
Agricultural laborers	0.56**	(0.13)	1.75
Unknown	-0.09	(0.09)	0.92
<i>Geographic region of residence (ref: South and islands)</i>			
Northwest	-0.89**	(0.06)	0.41
Northeast	-1.05**	(0.07)	0.35
Centre	-0.95**	(0.07)	0.39
<i>Housing tenure (ref: homeowners)</i>			
Renters	0.90**	(0.05)	2.45
Other ^(a)	0.31**	(0.07)	1.37
Unknown	-0.19	(0.33)	0.82
<i>Intercept</i>	-2.19**	(0.10)	

N = 19,664

Source: Multipurpose Household Survey, 2001 (* p<.05; ** p<.01)

Notes: ^(a)Includes dwelling that are not owned but for which no rent is typically charged;

The probit model for not having a landline connection, substantially presents the same results of the logit model discussed in the previous section, while the probit model for not having a mobile phone needs further discussion. The probability of having a mobile phone is clearly negatively affected by age. While, among the various types of households, being singles or couples without children has a positive effect on not having a mobile phone, comparing to our reference category (couples with children). The level of education also matters: the higher the level of education, the higher the negative effect of this variable on the probability of not holding a mobile device. Eventually, social class also exerts some influence: considering statistically significant parameters only, farmers are less likely to own a mobile phone, while households of service-class and middle-class workers are more likely to own a mobile phone, when compared to our baseline (blue-collar workers) holding all other variables constant. Finally, our control variables largely behave as expected: being households living in the South or on the islands has a greater positive effect on the probability of not having a mobile phone, compared to households living in the other regions; while an increase in the number of working adults in a household has a negative effect on the probability of not holding a mobile device – that is consistent with the “re-productive work” hypothesis.

Joint predicted probabilities for the four types of phone arrangements are given in Table 4, for a few household profiles. They show up in a more immediate way as phone arrangements, and hence the noncoverage rate and its composition, are influenced by the considered social stratification variables.

The second household profile (Northeast, couple with children, 46-50 y.o., secondary education, middle class, 2 or more people working, homeowners) has a .98 (.96 + .02) probability of being covered by a landline sampling frame. It also has the same coverage probability (.02 + .96) when considering a possible mobile phone sampling frame. These type of households are highly covered by both a landline or a mobile telephone sampling frame. At the opposite, we can consider - among the poorly covered ones - the first (South & islands, couple without children, 61-65 y.o, no formal education, farmers, nobody working, homeowners) and the sixth (Northwest, single, 31-35 y.o, lower secondary education, middle class, 1 person working, tenant) household profiles in the table. The first has a .68 (.19 + .49) probability of being covered by a landline sampling frame, while the same probability is just .41 (.36 + .05) for the sixth profile. While the former has only a .29 (.10 + .19) probability of being included into a mobile sampling frame, the latter has .89 (.53 + .36) probability for the same outcome. To summarize, our results provide some evidence for systematic patterns in the exclusion of specific groups from phone sampling frames. These differences are consistent with other research on coverage error (Van Goor & Rispen, 2004) and are likely to be correlated with behaviors, attitudes and opinions, which often are the main objects of interest in phone surveys and as a consequence will bias the results from these enquiries.

Table 3. Estimates of a simultaneous bivariate probit model for the probability of having no landline telephone connection and no mobile phone

Variable	SINGLE EQUATION		BIVARIATE PROBIT	
	Coefficient	S.E.	Coefficient	S.E.
NO LANDLINE CONNECTION VS. CONNECTION EQUATION				
<i>Age group – RP (ref. : 51-55 y.)</i>				
16-30 years	1.15 **	(0.06)	1.15 **	(0.06)
31-35 years	0.86 **	(0.06)	0.86 **	(0.06)
36-40 years	0.49 **	(0.06)	0.49 **	(0.06)
41-45 years	0.37 **	(0.06)	0.37 **	(0.06)
46-50 years	0.24 **	(0.06)	0.25 **	(0.06)
56-60 years	-0.14 *	(0.07)	-0.14 *	(0.07)
61-65 years	-0.29 **	(0.06)	-0.29 **	(0.06)
65-70 years	-0.30 **	(0.07)	-0.30 **	(0.07)
71-75 years	-0.37 **	(0.07)	-0.37 **	(0.07)
76-80 years	-0.48 **	(0.07)	-0.48 **	(0.07)
81 years or more	-0.27 **	(0.07)	-0.27 **	(0.07)
<i>Household type (ref. : couples with children)</i>				
Singles	0.82 **	(0.03)	0.81 **	(0.03)
Couples without children	0.27 **	(0.04)	0.27 **	(0.04)
Single parents	0.38 **	(0.05)	0.38 **	(0.05)
Multifamily households and other	0.15 **	(0.05)	0.15 **	(0.05)
<i>Geographic region (ref: South & islands)</i>				
Northwest	-0.49 **	(0.03)	-0.49 **	(0.03)
Northeast	-0.58 **	(0.04)	-0.58 **	(0.04)
Centre	-0.52 **	(0.04)	-0.52 **	(0.04)
<i>Educational level (ref.: lower secondary educ.)</i>				
Higher/university education	-0.46 **	(0.06)	-0.46 **	(0.06)
Secondary education	-0.19 **	(0.04)	-0.19 **	(0.04)
Vocational training	-0.18 **	(0.06)	-0.18 **	(0.06)
Primary education	0.12 **	(0.04)	0.12 **	(0.04)
No formal education	0.48 **	(0.06)	0.48 **	(0.06)
<i>Social class (ref: blue-collar workers)</i>				
Service-class workers	-0.23 **	(0.05)	-0.23 **	(0.05)
Middle-class workers	-0.21 **	(0.04)	-0.21 **	(0.04)
Urban self-employed workers	-0.14 **	(0.04)	-0.14 **	(0.04)
Farmers	0.08	(0.06)	0.08	(0.06)
Agricultural laborers	0.32 **	(0.08)	0.31 **	(0.08)
Unknown	-0.06	(0.05)	-0.06	(0.05)
<i>Housing tenure (ref: homeowners)</i>				
Renters	0.50 **	(0.03)	0.50 **	(0.03)
Other	0.17 **	(0.04)	0.17 **	(0.04)
Unknown	-0.08	(0.18)	-0.08	(0.18)
<i>Intercept</i>	-1.25 **	(0.05)	-1.25 **	(0.05)

(continued)

Table 3. (continued)

Variable	SINGLE EQUATION		BIVARIATE PROBIT	
	Coefficient	S.E.	Coefficient	S.E.
NO MOBILE PHONE VS. MOBILE PHONE EQUATION				
<i>Age group – RP (ref. : 51-55 y.)</i>				
16-30 years	-0.41 **	(0.09)	-0.41 **	(0.09)
31-35 years	-0.24 **	(0.07)	-0.24 **	(0.07)
36-40 years	-0.07	(0.07)	-0.07	(0.07)
41-45 years	0.05	(0.06)	0.05	(0.06)
46-50 years	0.05	(0.06)	0.05	(0.06)
56-60 years	0.02	(0.06)	0.02	(0.06)
61-65 years	0.18 **	(0.06)	0.17 **	(0.06)
65-70 years	0.41 **	(0.06)	0.41 **	(0.06)
71-75 years	0.69 **	(0.06)	0.68 **	(0.06)
76-80 years	0.96 **	(0.07)	0.96 **	(0.07)
81 years or more	1.19 **	(0.07)	1.19 **	(0.07)
<i>Household type (ref. : couples with children)</i>				
Singles	0.88 **	(0.04)	0.88 **	(0.04)
Couples without children	0.56 **	(0.04)	0.56 **	(0.04)
Single parents	-0.11 *	(0.05)	-0.11 *	(0.05)
Multifamily households and other	0.34 **	(0.05)	0.34 **	(0.05)
<i>Geographic region (ref: South & islands)</i>				
Northwest	-0.24 **	(0.03)	-0.24 **	(0.03)
Northeast	-0.16 **	(0.04)	-0.16 **	(0.04)
Centre	-0.37 **	(0.04)	-0.37 **	(0.04)
<i>Educational level (ref.: lower secondary educ.)</i>				
Higher/university education	-0.26 **	(0.06)	-0.26 **	(0.06)
Secondary education	-0.15 **	(0.04)	-0.15 **	(0.04)
Vocational training	-0.13 *	(0.06)	-0.13 *	(0.06)
Primary education	0.34 **	(0.04)	0.34 **	(0.04)
No formal education	0.58 **	(0.05)	0.58 **	(0.05)
<i>Social class (ref: blue-collar workers)</i>				
Service-class workers	-0.38 **	(0.06)	-0.38 **	(0.06)
Middle-class workers	-0.17 **	(0.05)	-0.17 **	(0.05)
Urban self-employed workers	-0.06	(0.04)	-0.06	(0.04)
Farmers	0.14 *	(0.05)	0.14 *	(0.05)
Agricultural laborers	0.08	(0.08)	0.08	(0.08)
Unknown	0.04	(0.05)	0.04	(0.05)
<i>No. working members (ref: nobody)</i>				
One member	-0.61 **	(0.03)	-0.61 **	(0.03)
Two or more members	-0.75 **	(0.05)	-0.76 **	(0.05)
<i>Intercept</i>	-0.85 **	(0.06)	-0.85 **	(0.06)
ρ	0.00	0.00	-0.04	0.02

Source: Multipurpose Household Survey, 2001 (* p<.05; ** p<.01)

Table 4. Joint predicted probabilities (from the bivariate model in Table 3) for types of phone arrangements and selected household profiles

	No phone	Fixed Only	Fixed + mobile	Mobile only	Total
South & islands: couple without children, 61-65 y.o., no formal education, farmers, nobody working, homeowners	0.22	0.49	0.19	0.10	1.00
Northeast: couple with children, 46-50 y.o., secondary education, middle class, 2 or more people working, homeowners	0.00	0.02	0.96	0.02	1.00
Centre: couple without children, 41-45 y.o., secondary education, blue-collars workers, 2 people working, tenants	0.01	0.05	0.74	0.19	1.00
Northwest: couple without children, 61-65 y.o., higher education, service-class workers, nobody working, homeowners	0.00	0.16	0.84	0.01	1.00
Centre: couple with children, 46-50 y.o., lower secondary education, urban self-employed, 2 or more people working, homeowners	0.00	0.02	0.93	0.05	1.00
Northwest: single, 31-35 y.o., lower secondary education, middle class, 1 person working, tenant	0.06	0.05	0.36	0.53	1.00

Source: Multipurpose Household Survey, 2001

Note: Totals may not sum to 1.00 because of rounding.

7. POSSIBLE SOLUTIONS TO COMPENSATE FOR COVERAGE ERROR IN ITALY

Various solutions could be used to tackle coverage error. Some of them are quite general and could probably also be implemented in other countries while other modalities are specific to the Italian case.

One solution is to continue using landline telephone frames and weight the data according to a coverage error analysis based on a face-to-face survey, like the Multipurpose Household Survey. In this case, the main problem is timing of the release of the data: in the Multipurpose Household Survey, the final report is released one year after the data collection, while the micro dataset for secondary analysis is released two years later. For this reason, weighting would be difficult to implement, and some projections and assumptions will have to be made in order to make the weighting effective.

A strategy that can solve the timeliness of the release of the data would be organizing a face-to-face survey with a smaller sample tailored to measure phone usage only. Such a survey could be sponsored by the main research institutes - for example their industry's association - ASSIRM¹⁴ - or by a combination of research institutes, the National Institute of Statistics, and the Ministry of Telecommunication. Given the rapid spread of the phenomenon, we suggest collecting the data at least quarterly using a CAPI methodology, which can speed up the release of the final data set. For this specific survey, we propose to organize the questionnaire in two parts, a core section with questions on fixed and mobile phone usage, back-

¹⁴ <http://www.assirm.it>

ground information, and other information necessary to weight the data. Additional information can be collected to calculate indexes of call efficiency, such as the number of active SIM cards owned by the respondent. A second part could change over the different waves, addressing special topics, such as the propensity to answer a phone call on the mobile phone when the caller id does not belong to the list stored. The survey could provide up to date data that can be used to properly weight landline phone surveys, and give indications for multi-mode data collection methods.

Another possible solution to compensate for coverage error, when a face-to-face or mail survey is not feasible, is to use a dual frame and call cellular phones together with landline phones. This option is feasible but has a number of practical problems. First of all, the cost of calling a mobile phone is higher than calling a landline phone. For example, if we assume a 15 minutes phone survey with six calls to close the case for a landline phone and three calls for a cellular phone¹⁵, the final cost will be .90 Euro if calling a landline phone during reduced rate (after 6.30 P.M.), 2.17 Euro if calling during peak rate, and 3.45 Euro if reaching a cellular phone - no matter the time of the call. Cheaper rates may be arranged with alternative telephone providers, but in any case the call to mobile phones will be more costly. The only way to reduce the cost would be to call mobile phones from mobile phones. This solution has been implemented in Slovenia (Vehovar, Lozar Manfreda et al., 2004). One disadvantage is that interviewers would have to manually dial the number, slowing down the data collection process and foregoing the benefits of automatic dialing and scheduling embedded in many CATI softwares. Another idea is to use a mobile phone switchboard connected to the main telephone systems. These terminals turn calls between a landline phone and a GSM phone into calls between two GSM phones thus reducing the costs. Nokia, for example, produces such devices¹⁶. The next practical problem is of a more theoretical nature. For landline phone numbers the sampling frame is at the household level and the final sampling unit is not directly sampled (Callegaro et al., 2004). For this reason, survey organizations use a random criterion for selecting a member within the household. However for mobile phone numbers the sampling frame contains final sampling units and there is no need for any selection method. The mobile phone is personal by nature, and it is very unlikely that it is shared among different persons. These two frames need to be reconciled somehow and weighted accordingly.

Calling mobile phones also introduces three new issues. The *first* is the loss of geographic information, which in the case of a fixed phone is given by the prefix. Prefixes for landline phones are assigned based on the geographic level, and the boundaries generally coincide with the district level. However, mobile phone prefixes are assigned nationwide, and the only information that can be known is the type of phone usage, i.e. business vs. personal, since mobile phone companies assign different prefixes for business and for personal usage. The loss of geographic information prohibits use of mobile phone frames for local surveys (Callegaro, 2002). More precision can be achieved by contacting each mobile phone company about the way they assign mobile phone numbers and verifying if there is a geographical pattern. This information is very difficult to collect and our efforts have been unsuccessful so far. Mobile phone companies treat their numbering system as commercial secret, not to be divulged easily. The *second* issue is a high potential for large numbers of pending phone calls with unknown eligibility. This is due to the use of multiple SIM cards mentioned previously. In Italy a prepaid SIM card can be valid (still receive phone calls) for approximately one year from the last recharge. This explains our one-to-one SIM cards by residents ratio. Calling a mobile phone number that is unused but still valid will generate a voice mail disposition

¹⁵ We assume, for the sake of this simulation, that it takes more calls to select and reach the final sampling unit when calling a landline phone than when calling a cellular phone.

¹⁶ They are called PBX connectivity terminals. See <http://www.nokia.com/nokia/0,8764,43170,00.html>

code, or a “customer has the mobile phone off or is out of area” disposition code that creates an unknown eligibility final disposition code (Callegaro et al., 2004). The unknown eligibility case counts against any response rate formula; moreover, it generates many inefficient phone calls because that number has to be called for the entire survey period before it is assigned the final unknown eligibility disposition code. The *third* issue is a survey eligibility problem. The minimum age at which a mobile phone is owned has declined over the years: in 2000 41.4% of the Italian population between 11 and 14 years and 76.3% between 15 and 19 years had a mobile phone (ISTAT, 2002). Because of this, one of the first questions in a mobile phone survey should assess the age of the owner in order to check whether he or she is included in the target population of the study.

A fourth solution could be to use a cellular phone frame only. Specific problems related to the use of mobile phones, discussed above, do apply. Moreover, in this scenario the noncoverage rate would be even greater than with a landline sampling frame. Considering both landline-only households and no-phone households, we can estimate the non coverage rate for 2002 of 24.6% (20.7 + 3.9). As we can see from Figure 1, this noncoverage rate is higher than that generated by current landline phone frames. This strategy can be used in the future, since the trend of landline-phone-only households is decreasing while the trend for MPO households is going up, possibly reaching a level where almost everybody will have a mobile phone. When calling a mobile phone, a question asking how many active SIM cards the user owns would be crucial for weighting the data. The presence of multiple numbers connected to the same person increases the likelihood of being selected. This is similar to the weighting procedures applied to multiple phone lines in fixed telephone surveys (Massey & Bothman, 1988).

Another solution would be to use to a multimode contact strategy. The sample can be extracted using voting lists that are available in every municipality and are updated every six months¹⁷ (Corbetta, 1999). In this case, only non-citizens, people below eighteen years old, and citizens who cannot vote (justice or mental problems, for example) are not included in the list. The list of voters consists of a name and an address. The list can be matched against the landline telephone directory to obtain a phone number. This procedure will miss respondents that are not listed in the telephone directory (5.7%)¹⁸, mobile-phone-only respondents, and respondents without phones. A mail survey can be sent to the unmatched addresses asking them to fill out the questionnaire and send it back, to conduct it online, or to call a toll free number in order to answer the questions. Some mobile phone numbers can be matched using voluntary mobile phone directories available online. In the future the implementation of a mobile phone directory will increase the percentage of possible matches. Italy, acknowledging a European Community directive, is working toward a “single telephone directory” with landlines and mobile phones. Lastly, for the people that did not answer, an interviewer can be sent either to conduct the interview, or to bring a cellular phone and give it to the respondent in order to be interviewed by a centralized CATI system of the survey organization. The latter solution saves money and it is more efficient than having professional interviewers out in the field (K. L. Tucker, 2004).

¹⁷ The voting list is organized by voting districts containing up to 800 voters and is commonly used for multi-stage sampling.

¹⁸ Authors' calculations from Multipurpose Household Survey (Istat), 2001.

8. CONCLUSIONS

Using Italy as a case study in this paper, we analyzed coverage error and coverage rate issues, discussed the relevance of this problem, its evolution, and made comparisons to other countries. We used the data from the Italian Multipurpose Household Survey to study changes in telephone penetration and usage during the last seven years. With the same data we were able to measure the bias of some statistics if a landline only sampling frame is used in collecting the data and to illustrate how different phone arrangements and noncoverage are stratified in the Italian society.

The increase of mobile-phone-only households is creating the premise for larger coverage error, as long as solely landline phone sampling frames are employed. The new phenomenon poses a threat to the survey industry that uses the phone as the single mode of data collection (Vehovar, Callegaro, & Kuusela, 2004; Vehovar, Lozar Manfreda et al., 2004). In Italy, and many other countries as Figure 3 shows, noncoverage rates derived from MPO households and from no-phone households are at levels that cannot be ignored. Our findings suggest that the probability of falling into one of the four possible categories of phone arrangement does vary by household type, socioeconomic characteristics, educational level and age of the RP of the household, as well as geographic location. Landline sampling coverage is clearly biased.

Given a noncoverage rate of 17% (2002) and its different incidence among social strata, it is likely that estimates from landline phone surveys for variables – conditions, behaviors and opinions - correlated with main social stratification variables would be affected by not negligible coverage errors.

On the other hand, it seems that it is not the time for mobile phone surveys yet. Calling a mobile phone is different from calling a landline phone in terms of sampling issues, interview situations, and technical problems. It is still too soon to judge the quality of a survey on a mobile phone and there are indications from media researchers that a cellular phone is seen as a very private device with different social functions than a fixed phone (Katz, 2003; Katz & Aakhus, 2002). Survey researchers should set up experiments comparing responses from a fixed phone survey and a mobile phone survey to verify if there is a *mobile phone response effect*. Another topic that worries survey researcher is response rates for mobile phone surveys (Fucks, 2000). Since a mobile phone is seen as very private and because there are almost no mobile phone directories, a call to a mobile phone can be seen as an invasion of one's privacy. Last but not least, noncoverage rate for a possible mobile phone sampling frame is still higher (24.6% in 2002) than noncoverage rate for a landline sampling frame and it is similarly biased.

To summarize, we are in a situation of transition where using either a landline frame only or a mobile frame only, is likely to produce a significant coverage error. For this reason, we have introduced a discussion on few strategies that could be useful when switching from a household level frame (fixed phone) to a personal level frame (mobile phone). Further research on these strategies and their possible implementation is obviously needed.

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APPENDIX A. ADDITIONAL TABLES

Table A1. Summary statistics, Multipurpose Household Survey sample, 2001

	%
<i>Age group – RP</i>	
16-30 years	4.3
31-35 years	7.5
36-40 years	10.3
41-45 years	10.1
46-50 years	9.6
51-55 years	10.4
56-60 years	8.4
61-65 years	9.3
65-70 years	8.7
71-75 years	8.8
76-80 years	6.8
81 years or more	5.8
<i>Household composition type</i>	
Single	23.0
Couple	18.6
Couple with children	43.8
Single parent	8.2
Multifamily households/other c.	6.3
<i>Highest (couple) level of education</i>	
Higher/University (ISCED 5-6)	10.1
Secondary (ISCED 3-4)	24.4
Vocational training (ISCED 3)	6.5
Lower secondary (ISCED 2)	24.9
Primary (ISCED 1)	26.9
No formal education	7.2
<i>Geographic region of residence</i>	
Northwest	22.5
Northeast	20.5
Centre	19.9
South / Islands	37.2
<i>Household social class</i>	
Service class	15.7
Middle class	21.4
Urban self-employed	25.3
Farmers	7.6
Blue collars	20.2
Agriculture laborers	2.0
Missing	7.8
<i>Housing tenure</i>	
Homeowners	72.0
Renters	17.7
Other	9.8
Missing	0.5
<i>N</i>	<i>19664</i>

Source: Multipurpose Household Survey, 2001

Note: Totals may not sum to 100.0 because of rounding.

Table A2. Households by phone arrangements and selected socioeconomic indicators, Multipurpose Household Survey sample, 2001 – Summary table

	No phone	Fixed only	Fixed + mobile	Mobile only	Total	
<i>Age group – RP</i>	%	%	%	%	%	
16-30 years	3.4	2.9	51.2	42.5	100.0	
31-35 years	1.8	3.1	67.2	27.9	100.0	
36-40 years	1.4	4.4	78.1	16.1	100.0	
41-45 years	1.5	5.2	80.7	12.6	100.0	
46-50 years	2.0	5.1	83.5	9.5	100.0	
51-55 years	1.3	7.2	84.2	7.3	100.0	
56-60 years	2.4	12.8	79.1	5.8	100.0	
61-65 years	3.6	24.1	67.5	4.8	100.0	
65-70 years	6.0	38.0	51.9	4.1	100.0	
71-75 years	7.2	52.6	36.8	3.5	100.0	
76-80 years	8.6	64.0	25.3	2.0	100.0	
81 years or more	15.9	64.8	17.5	1.8	100.0	
<i>Household composition type</i>						
Singles	11.3	44.1	30.2	14.3	100.0	
Couples without children	3.2	38.1	51.0	7.6	100.0	
Couples with children	0.9	5.8	84.1	9.1	100.0	
Single parents	3.3	13.6	70.9	12.3	100.0	
Multifamily households/other c.	3.4	16.2	70.8	9.6	100.0	
<i>Highest level of education</i>						
Higher/University (ISCED 5-6)	0.5	6.4	86.0	7.1	100.0	
Secondary (ISCED 3-4)	1.0	7.8	78.4	12.8	100.0	
Vocational training (ISCED 3)	0.6	10.1	78.4	11.0	100.0	
Lower secondary (ISCED 2)	2.3	13.5	68.8	15.4	100.0	
Primary (ISCED 1)	6.3	42.7	45.2	5.8	100.0	
No formal education	9.3	45.2	39.8	5.7	100.0	
<i>Household social class</i>						
Service-class workers	0.6	10.2	82.8	6.4	100.0	
Middle-class workers	0.6	6.5	81.3	11.5	100.0	
Urban self-employed workers	4.2	34.4	54.5	6.8	100.0	
Farmers	12.0	47.9	34.7	5.4	100.0	
Blue-collar workers	3.2	13.1	66.2	17.5	100.0	
Agricultural laborers	7.4	21.3	47.2	24.1	100.0	
<i>Household geographic distribution</i>						
Northwest	2.4	22.4	66.0	9.2	100.0	
Northeast	2.4	22.2	67.9	7.5	100.0	
Centre	2.2	20.1	70.1	7.6	100.0	
South and islands	7.1	22.6	56.3	14.0	100.0	
<i>Housing tenure</i>						
Homeowners	3.6	22.3	67.1	7.0	100.0	
Renters	5.6	19.3	52.7	22.4	100.0	
Other	5.0	24.4	57.3	13.3	100.0	
<i>All households</i>	N= 19,664	4.1	22.0	63.6	10.3	100.0

Source: Multipurpose Household Survey, 2001

Note: Totals may not sum to 100.0 because of rounding.