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THE IMPACT OF TERRITORIAL FACTORS ON THE TOTAL NON-RESPONSE ERROR IN THE EUROPEAN UNION – SURVEY ON INCOME AND LIVING CONDITIONS (EU-SILC)

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1. BACKGROUND AND INTRODUCTION

Accuracy is one of the main dimensions in the broader framework of data quality. Commonly expressed in terms of total survey error, accuracy basically evaluates the two components of sampling and non-sampling errors. Although the non-response error is only one of the potential sources of non-sampling errors, it is one that has attracted much interest. Over the last decades, the total non-response in surveys, especially household surveys, appears to have increased in several developed countries (Atrostic *et al.*, 2001; de Leeuw and de Heer, 2002; Curtin *et al.*, 2005). It indicates a clearly visible "flaw" in survey operations with important implications during design and analysis (Lessler and Kalsbeek, 1992). Currently, one of the main research trends has been focusing on factors which operate at different levels and influence the survey cooperation (Groves and Couper, 1998) – *i.e.*, survey organization and design (meso level), interviewers' behaviors or interactions interviewers/householders (micro level), socio-economic and cultural environment (macro level) – and on their statistical impacts, in terms of precision and accuracy, on survey estimates.

This paper discusses a framework for evaluating the accuracy of the Italian section of European Survey on Income and Living Conditions (EU-SILC) with focus on non-sampling errors related to several components of total non-response at household level. Following a classical hierarchical approach (Platek and Gray, 1986; Drew and Gray, 1991; Hidiroglou *et al.*, 1993) and the AAPOR (2008) definitions, a set of basic quality indicators is proposed to monitor both process and product quality. Then, as regards to the 2004 and 2005 waves, classes of quality indicators, each of them related to specific aspects of unit non-response error, are obtained by aggregating in a suitable way the previous basic quality indicators; finally, they are broken down by different territorial levels according to the NUTS classification[1]. Moreover, in order to investigate the territorial perspective and its

[1] The Nomenclature of Territorial Units for Statistics (NUTS) is a statistical classification worked out by Eurostat to meet comparability requirements. Coherently with the geographical-

effects on total non-response errors, a "null" model (one-way random effects ANOVA model) is tested. Indeed, as the EU-SILC survey is inherent in socio-economic events, we should expect that its participation levels are also affected by some territorial characteristics. As stressed, more than once, by Groves and Couper (1998), background affects the choice to participate in a survey in shaping the context in which the decision is made. Beyond the national level, these effects may also occur at a higher degree of territorial disaggregation where a variety of contextual factors might influence both the interviewers' behavior and the predisposition/reaction of householders, that is to say the survey participation. In this light, the paper also aims at assessing the geographical differences in the probability of EU-SILC participation by exploring some background factors potentially correlated with the survey participation at a sub-national level. At this end, we investigate a variety of territorial indicators and group them into homogenous sets of economic, demographic and social attributes; then, a multinomial logistic regression model (Hosmer and Lemeshow, 2000; Groves and Couper, 1998) is estimated by the previous sets of covariates in order to predict the probability of survey participation in its various dimensions. In such a way, the final goal of the paper is sketching a territorial quality profile although limited to the unit non-response error components. Empirical results may be an interesting starting point to identify those crucial factors because of them some areas show a more difficulty to be interviewed in order to define ad hoc corrective interventions.

2. MAIN CHARACTERISTICS OF THE ITALIAN SECTION OF EU-SILC SURVEY

The Survey on Income and Living Conditions is the main reference source for comparative statistics on income and social exclusion in Europe coordinated by Eurostat. It has been developed on the experience of the pioneer European Community Household Panel (ECHP) as a flexible instrument to anchor in each National Statistical System[2].

In Italy, following three pilot surveys in 2003, full-scale EU-SILC surveys have yearly been carried out by Istat since 2004, covering as target population only people living in private households whose information are collected by PAPI

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administrative divisions of Member States, the NUTS system provides a hierarchical, exhaustive and non-overlapping set of units. It proceeds step-by-step from higher units (NUTS1) to lower ones (NUTS2, NUTS3), increasing the level of disaggregation of territorial indicators. In Italy, there are 5 areas at NUTS1 level (main socio-economic macro-regions), 20 NUTS2 areas (administrative regions) and 110 NUTS3 areas (provinces).

[2] The EU-SILC project was launched in 2003 through a gentleman's agreement in seven European countries and implemented on a legal basis since 2004. The pioneer ECHP – a multidimensional survey based on a pure longitudinal panel – has traditionally been the primary data source for constructing many indicators in the field of income, poverty and social exclusion during the period 1994-2001. Cross-national comparability was achieved through a standardised design and common technical procedures all over the countries with coordination of the national surveys by Eurostat (more details in Peracchi 2002, Quintano et al. 2007).

technique to manage the high complexity of survey topics. Anyway, in order to guarantee the coherence with the Labour Force Survey, individuals aged 15 are also interviewed, making an extension to the European Regulation n. 1177/2003 according to which "the main information collected shall pertain to persons aged 16 and over in the previous calendar year". The Italian section of EU-SILC survey is based on a two-stage sampling design where the municipalities are the primary sampling units (PSUs) and the households the second stage units (SSUs). Inside each administrative region, PSUs are stratified according to their demographic size and the total of residents in each stratum is approximately constant to guarantee self-weighting design in each region. PSUs' stratification divided the national territory into 288 strata and inside each administrative region three different typologies of strata are identified: self-representing and non self-representing of first and second order. However, inside each stratum, municipalities are selected with a probability proportional to their demographic size by means of a systematic sampling method by Madow (1949). Finally, inside each selected municipality, households are drawn from municipality-registers with equal probability by a systematic sampling.

In order to meet both the cross-sectional and longitudinal requirements, an integrated design based on four-year rotational groups is adopted. The complete sample is composed of four independent rotational sub-samples, each of them, similar in size and design and representative of the whole population, is kept during four waves of the survey; every year, one-fourth of the complete sample is renewed, replacing the group entered four years before. Therefore, once the integrated system is fully established (from 2007 onwards), the cross-sectional sample for any one year consists of four replications, each of them placed in a different step, in terms of number of participated waves, of the longitudinal path. In other words, each year one of the four longitudinal replications is dropped and a new one added, giving an overlap of approximately 75% between successive waves. In such a way, both cross-sectional and longitudinal data are obtained from the same common set of units; this overlap, highly economical, maximizes the internal consistency between longitudinal and cross-sectional statistics produced from the survey (Verma, 2006)[3].

As regards to wave 2004, each panel group (A, B, C and D) is composed of 288 PSUs and nearly 8,000 SSUs; then, the complete cross-sectional sample includes 762 municipalities and almost 32,000 households (tables 1 and 2).

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[3] Inside each administrative region, demographic threshold to define a municipality as self-representing directly depends on the minimum number of households to interview, on the average number of components per household and inversely on sampling rate. Firstly, municipalities with a demographic size higher than the threshold are considered self-representing units; strata by themselves, they are automatically included in each of the four longitudinal sub-samples. Secondly, non self-representing strata of first order include a small number of municipalities with a high demographic size; two municipalities are drawn from every stratum, each of them is included into two of the four longitudinal sub-samples. Thirdly, non self-representing strata of second order include municipalities with a lower demographic size; four municipalities are drawn from every stratum, each of them is included into only one longitudinal sub-sample.

TABLE 1

EU-SILC sampling design: Primary Sampling Units stratification (PPSs) – wave 2004

	Strata	Municipalities
Self-representing	110	110
Non self-representing of first order	30	60
Non self-representing of second order	148	592
Total	288	762

Source: EU-SILC Quality Reports (2004 and 2005)

As regards to 2005, in addition to the amount of respondent units in the previous wave (2004) with respect to the longitudinal sub-samples B, C and D, a refreshed group of roughly 8,000 households (E) has been introduced (table 2)[4].

TABLE 2

EU-SILC sampling design: composition of longitudinal replications in terms of Secondary Sampling Units (SSUs) waves 2004 and 2005

Wave	A	B	C	D	E	Total
2004	7,956	7,993	7,998	8,045	–	31,992
2005	–	6,179	6,185	6,414	8,008	26,786

Source: EU-SILC Quality Reports (2004 and 2005)

3. A SET OF BASIC QUALITY INDICATORS: A THEORETICAL FRAMEWORK

On the basis of the European Commission Regulation n. 28/2004, implementing Regulation n. 1177/2003 of the Council and European Parliament concerning Community Statistics on Income and Living Condition as regards the detailed content of the intermediate and final quality reports, Member States adopting a rotational sampling design "provide information about non-response for new replications". A starting point for thinking about survey non-response is to consider the different ways in which it may occur (Abraham *et al.*, 2006). In this section, in order to investigate in-depth the unit non-response error in the Italian segment of EU-SILC survey, the several reasons explaining why household units have failed to respond are explored. In a second step, taking into account the information reported by interviewers in the Household Registers, a set of statistical indicators on survey performance is computed in order to measure the magnitude to which total non-response occurs. Since these quality indicators are constructed only then the survey process is completed, they could determine weaknesses in the sequence of the main survey activities during which unit non-response may arise.

[4] The rules for the follow-up of sample individuals, households and co-residents in the EU-SILC longitudinal component are defined by the Commission Regulation n. 1982/2003, implementing Regulation n. 1177/2003. In particular, with regard to households, the following categories are dropped from the survey: non-enumerated a single year due to the impossibility of locating the address, the address being non-residential or unoccupied, lost (no information on what happened to the household), or the household refusing to cooperate; non-contacted the first year of the panel or non-contacted two consecutive years due to the impossibility of accessing the address, because the whole household is temporarily away or unable to respond due to incapacity or illness.

Starting from the total number of households thought to belong to the EU-SILC sample for the 2004 and 2005 waves before the survey process begins, non-respondents are categorized according to the main reasons of non-response and, in order to describe distinctive aspects of unit non-response process, different types of non-participation rates are computed in a reasonable manner. In other words, to avoid all potential sources of unit non-response could be considered equivalent to one another, non-participation process is dissected into different components, each of them is singularly monitored through an appropriate basic quality indicator.

Firstly, the *Out-of-scope rate*, defined as ratio of the number of ineligible units to the total number of units, provides the proportion of households whose status does not meet minimum residency requirements stated by the European Regulations (2003). According to the standard EU-SILC definitions as regards the target population and collection units, institutionalized households or transferred outside the national territory on a permanent or long-term basis and households with all deceased members are considered out-of-scope. Verifying the quality of survey design in selecting eligible units from a frame, the out-of-scope rate provides information to resolve how many ineligible units will result at the survey data gathering stage. Then, the process of contacting the sampling households is re-examined in order to identify the main causes of unsuccessfully location. In particular, location refers to the stage during the survey in which interviewers, having been given relevant information, attempt to contact the set of sampling units (Lepkowski and Couper, 2002) and, in this context, accessibility is surely a key factor influencing success in location efforts. More generally, non-contacts are defined as those addresses or households that are known to be eligible but the interviewer has not managed to make contact at any visit. The following quality indicators are proposed, each of them is referred to a specific category of households that cannot be contacted for a specific reason:

Not-located address rate, as ratio of the number of addresses cannot be located to the number of total in-scope households (this latter also include the unresolved units, that is to say sample units of unknown eligibility), which allows to define the incidence of sample households living in secluded areas or of controlled access (*i.e.*, locked apartment buildings, housing subdivisions with security checkpoints, no-trespassing enforcement and any physical impediment that prevent easy location of the household) such as an interviewer may be unable to find, locate and contact them[5].

Unable-to-access rate, as ratio of the number of addresses unable to access to the number of total eligible units, which detects the incidence of sample households whose location is unlikely to reach because of natural calamity, atmospheric factors, and so on.

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[5] As argued by Groves and Couper (1998), in face-to-face interviews, structural aspects of sample housing units can affect the ability of an interviewer to contact the household. These appear at all levels of socio-economic status of population. In particular, in high-crime areas residents with door grates or alarm systems may not readily answer the door when a stranger calls, opting to have contact only with persons known to them already.

Incorrect address rate, as ratio of the number of wrong addresses to the number of total in-scope units; it aims at monitoring the amount of untraceable households across national territory due to inexistent or non-residential addresses, unoccupied or not principal residences and all other situations when selected households don't live on the given address. Reflecting potential frame deficiencies, it may also be considered as expression of "health condition" of municipality-registers. At this end, the *Frame error rate* is also defined; it monitors the ineligible units and, within the in-scope ones, the non-contacted units due to frame errors in relation to the total sampling households.

Secondly, since only then an interview succeeds in solicitation attempts a sample household becomes a participant in the survey, we inspect all other categories of total non-participation occurred during solicitation in which successfully contacted households are asked to participate (Lessler and Kalsbeek, 1992). Their incidence is evaluated through quality indicators, each of them is referred to a particular category of contacted households that failed to participate in the interview:

Refusal rate, as ratio of decisive refusals to the in-scope units net of non-contacts (due to not located or incorrect addresses and addresses unable to access); it recognizes the proportion of households unwillingness to participate, meaning that an aware decision is made by the same units not to participate on the basis of several causes (*i.e.*, fear, apathy, distrust, lack of time, ...).

Unable-to-respond rate, as ratio of households lack of ability to participate to the number of eligible units net of non-contacts; it detects the incidence of unit's inability to participate, whether unavailable or because of physical health problems that rob them of the energy necessary to answer (or they have the energy but not the physical ability), emotional or language disorders that prevent them from comprehending the survey questions, and so on.

Non-achievement rate, as ratio of residual located non-participant households to the in-scope units net of non-contacts; it includes all those residual non-participant units who do not fit in any of previous categories. In particular, the *Temporarily not-at-home rate* is the ratio of households temporarily not-at-home during the fieldwork to in-scope units net of non-contacts; it measures the incidence of successfully contacted units but unsuitable for interview due to the absence from home during the fieldwork.

4. THE PROCESS OF CONTACTING THE HOUSEHOLDS AND THEIR ACTUAL COOPERATION

In the implementation of EU-SILC survey design, Istat defined the maximization of the survey participation as a priority objective although the control of non-response on income items is never neglected. Several strategies are taken to control respondent burden to encourage response during the different waves and to ensure high quality of collected information[6].

[6] This strategy is practically compulsory for a national statistical institute. Conversely, as regards to SHIW (Survey of Households' Income and Wealth) design, Bank of Italy defines as an absolute priority the minimization of non-response on income items although a lower overall participation

Out-of-scope rate catches the incidence of sampled units whose ineligibility was discovered during the fieldwork period – equal to 0.64% (wave 2004) and 1.15% (wave 2005) of the whole cross-sectional sample (table 3) – although it neglects the sampled units of unknown eligibility. This latter refer to all those unsuccessfully contacted units that cannot be correctly classified since enough information could not be available. Nevertheless, in the later waves, it is also critical to verify if the eligibility status has been kept over time since a household interviewed in the first wave may split up to form additional eligible households[7] or all members may leave the survey population so the same household becomes out-of-scope. However, as regards to the wave 2005, the slightly higher incidence of ineligible units is characterized by households with all deceased members (0.53%) followed by institutionalized households (0.32%) or transferred abroad on a permanent/long-term basis (0.30%).

Theoretically, the process of contacting a sample household is rather straightforward, but its success also depends on any impediment interviewers may encounter in gaining location to the housing unit. In EU-SILC, roughly one-fifth of overall non-participation is ascribable to failures to make contact; indeed, the incidence of non-contacted households related to the total of non-participant eligible households is equal to 21.77% (wave 2004) and 18.74% (wave 2005). However, further insights may be highlighted through a more detailed analysis.

Being EU-SILC a face-to-face survey, a rather important share of non-contacts comes from physical impediments to locate or access the housing unit so strong to prevent all contact with the sample household. However, the incidence of unable-to-access and not-located addresses (related to eligible household units) is substantially similar in the two waves. The largest incidence of non-contacted households related to eligible units, substantially decreasing over the two waves (-1.76), comes from all those situations referable to inexistent or non-residential addresses, unoccupied or not principal residences; in other words, to all those factors reflecting potential errors in the registers of sampling municipalities[8]. These registers, managed by municipalities, play a fundamental role in EU-SILC sampling design. Nevertheless, they may be affected by potential errors, out of

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rate might be obtained. In order to support response, the main steps taken by Istat concern, for example, the questionnaire structure in terms of items organization and their graduality (from general and neutral questions to more specific ones); the large investments in training courses for interviewers to obtain high level of performance and the definition of a detailed interviewers' handbook aiming at assisting them during all the fieldwork; mailing two advance letters by the president of Istat and by the mayor of the municipality where the household lives to convey the purpose of EU-SILC survey and to alert the household to an upcoming visit by the interviewer.

[7] Taking again the rules for the follow-up of sampling units, co-residents living in a household containing at least one sample person coming from a sampled household are followed until the sample person lives in that household. Furthermore, anyone temporarily away but who is still considered as household member is covered in the household he belongs to; finally, moving to a private household within the national territory covered in the survey, he is followed to the new location of the household.

[8] Together, not-located and unable-to-access addresses stand for more than one-fifth of total non-contacted households, 21.21% (2004) and 27.01% (2005). Therefore, the largest share of total non-contacted households comes from incorrect addresses, higher than 70% on both the waves.

control of researchers, so ineligible units might be included and eligible units excluded. As any *precautionary* control to evaluate the frame accuracy is precluded, only a *subsequent* control at the end of the fieldwork period could be carried out. Although influenced by out-of-scope units, the "health condition" of municipality-registers appears to have improved over the two waves with a decreasing frame error rate from 4.67% in 2004 to 3.42% on the later wave 2005 (table 3).

TABLE 3

EU-SILC cross-sectional sample: eligibility, non-contact and non-participation rates – waves 2004 and 2005

Quality indicator	2004	2005
Out-of-scope rate	0.64	1.15
Not-located address rate	0.85	0.53
Unable-to-access rate	0.24	0.32
Incorrect address rate	4.06	2.30
Frame error rate	4.67	3.42
Refusal rate	8.62	7.74
Unable-to-respond rate	1.09	0.91
Non-achievement rate	9.78	5.44
Temporarily not-at-home rate	2.73	3.71

As discussed by Lepkowski and Couper (2002), once a household has been successfully contacted, other aspects may further influence the householder's decision to participate in the survey during solicitation. In particular, in EU-SILC survey, where cross-sectional and longitudinal requirements are combined, the households' willingness to cooperate is surely shaped by a variety of background factors at the time of the request as well as their recollection of the prior wave experience.

First, either at the initial or a later contact, householders' reluctance to the survey may be so strong that they explicitly refuse to participate, providing no reason or superficial answers for this. In EU-SILC survey, the incidence of decisive refusals related to the total of non-participant eligible households is equal to 34.59% (wave 2004) and 44.66% (wave 2005). In such a way, as regards to both the waves, most of the total non-participation comes from non-contacts and, most importantly, refusals to cooperate[9].

Nevertheless, a refusal to participate in the survey presumes a previous successfully contact with the household; therefore, non-contacts and refusals concern two different hierarchical levels of the same event, that is the total non-participation. Indeed, further insights may be emphasized analyzing the non-respondents given contact; in other words, by comparing all those successfully contacted households but did not answer the questionnaire, whatever the reason, to initial sample eligible households net of unsuccessfully contacted units. Revealing, within certain limits, how well interviewers did in soliciting participation once households have been located and contacted, the incidence of successfully con-

[9] Together, non-contacts and decisive refusals stand for more than one-half of total non-participation (56.36% and 63.40% for waves 2004 and 2005, respectively). An other substantial share of total non-participation may be decomposed as follows: incapacitation to answer (4.39% and 5.24% for the two waves), temporarily not-at-home during the fieldwork period (10.96% and 21.39%) and a residual share (28.29% and 9.97%) of whom 1.94% and 1.66%, respectively, are addresses where either the householder or the partner regularly lives.

tacted units who refuse to give the required information has slightly been decreasing over the two waves (-0.88). Non-participation in survey because of incapacitation of contacted units to answer the questionnaire, regardless of how willing the same households might be, appears to have sketched a similar pattern.

Second, the incidence of successfully contacted households failing to participate for reasons other than refusal or incapacity, measured by the non-achievement rate, has significantly been declining over the two waves (-4.34). It also includes a substantial share of non-participant units because not at home during the fieldwork whose incidence appears to have slightly increased (+0.98). Unfortunately, the non-achievement rate includes a residual share of non-participant households already successfully contacted, whose reasons are not specified. In particular, it is worth to note the addresses where either the householder or the partner regularly lives whose incidence has vaguely been decreasing over waves (table 3).

5. A SYNTHESIS OF BASIC QUALITY INDICATORS: A HIERARCHICAL APPROACH

In order to evaluate some features of the broader issue of unit non-response in the Italian segment of EU-SILC survey, we aggregate the previous basic quality indicators according to a bottom-up approach within the hierarchical framework (Platek and Gray, 1986; Drew and Gray, 1991; Hidiroglou *et al.*, 1993; Lynn *et al.*, 2001). In other words, basic information concerning specific aspects of total non-participation are linked together step-by-step to form three classes of synthetic quality indicators.

First, starting from the bottom of the hierarchical framework, the *Cooperation rate* is obtained as a suitable aggregation of three basic quality indicators (*i.e.*, refusal, unable-to-respond and non-achievement rates). It measures the incidence of successfully interviewed households of all eligible units ever contacted and, thus, the actual survey participation; it also reveals the scenario of cooperation propensity in a longitudinal survey such as EU-SILC.

Second, at a higher level of the hierarchical framework, the *Contact rate* is a combination of other three basic quality indicators (*i.e.*, not-located address, unable-to-access and incorrect address rates), each of them evaluates substantive aspects of the process of contacting sample households. It quantifies the proportion of all cases in which some responsible housing unit member was reached (successfully contacted households/in-scope units) and allows to discriminate the potential share of households which could actually cooperate to survey.

Third, the overall *Response rate* is achieved by the product of the two above mentioned indicators, contact and cooperation rates. Defined as ratio of successfully respondent households to total sampling units net of out-of-scope households, the overall response rate accounts for the incidence of eligible households providing "usable information" by the cut-off time for data collection[10]. More-

[10] A great many international literature considers the non-response as a *continuum* whose boundaries are total non-response and correctly completed questionnaire. Consequently, the acceptance

over, including only the number of eligible households in the denominator, it may be considered as a conditional response rate to evaluate the efficiency of data collection procedure alone.

5.1. *Evaluating the actual survey participation over waves*

Since the EU-SILC survey design is based on an integrated system of four-year rotational panels for households, it needs additional insights about the unit non-participation over waves. In particular, a more critical aspect of EU-SILC data quality is the extent to which households are successfully interviewed in the first wave, then followed-up in the second one and so on. Indeed, in Italy, the rotational panel design involves that three-quarters of the initial sample in 2004 are asked to take part in the follow-up interview in 2005 and one-quarter of the total sampling units in 2005 are made up of new sample households. Likewise in 2006 three-quarters of the 2005 sample will be asked to take part again and one-quarter will be refreshed, and so on. In this light, in order to assess the evolution of sample size and, consequently, the degree of success in interviewing the same set of households over waves, the synthetic indicators – cooperation, contact and response rates – are computed as regards to both the waves for the complete cross-sectional sample and for each longitudinal sub-sample.

As illustrated in table 4, as regards to wave 2004, more than three-fourth of initial cross-sectional sample (net of ineligible households) has been successfully interviewed (76.35%) and this performance seems to have significantly improved in the subsequent wave 2005 (83.21%). Although a large disparity across national territory may be observed, the response rates for the Italian section of EU-SILC survey are consistently higher than the European average[11]. Contact difficulty appears to be a significant non-response factor in the first wave (5.15%) and relatively smaller in the later 2005 (3.15%). Similarly, the degree of cooperation in the survey is greatly improved over waves (+5.41)[12]. However, in the second wave, the lower values of the overall (cross-sectional) non-contact and non-cooperation rates are essentially due to the lower non-contact and non-cooperation rates re-

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threshold to define "usable information", below which units are considered non-respondents, depends on values of provided data for some items in relation to the survey cognitive purposes.

[11] As regards to 2004, the European average of total non-response rates at household level is about 30%. The highest non-response rates are recorded for Belgium and Luxembourg (slightly more than 50%), while the lowest levels for Finland, Portugal and Greece (about 10-15%). Because of its increasing complexity due to a larger sample size, IT-SILC response rates are consistently lower than the corresponding ECHP ones. Indeed, the initial ECHP response rates, around 70% for the EU as a whole, considerably varied across countries, from 90% in Greece and Italy to only 38-40% in Luxembourg and Germany.

[12] In order to ensure good quality of collected information and to avoid high non-response rates, the EU-SILC survey is designed to keep respondent burden controlled. Indeed, as exemplified by Clemenceau et al. (2006), although the detailed collection of income components can be cumbersome, the target is to report limit the total length of interviewing household in average below 60 minutes. In 2004, despite the average of household interview duration amongst Member States carrying out full surveys is about 55 minutes, in Italy it amounts to 66 minutes and it has increased to 68 minutes in the subsequent wave.

lated to the three sub-groups of households previously interviewed (B, C and D). In particular, as regards to the process of contacting households, in the first wave similar non-contact rates, usually around 5%, are revealed for all the four longitudinal sub-samples. A regular decreasing pattern of non-contact rates, slightly higher than 2%, is disclosed in the later wave 2005 for the sub-samples B, C and D, except for the refreshed sample households (E) whose contact rate is consistently similar to the previous ones. Analogous considerations concern the actual non-cooperation of successfully contacted households; indeed, although similar non-cooperation rates, roughly 19-20%, are detected for all the four longitudinal sub-samples in 2004, they have regularly decreased in the second wave 2005, approximately 12-13%, with the same exception of the refreshment sub-sample[13].

TABLE 4 (a)

EU-SILC cross-sectional and longitudinal samples: synthetic quality indicators – wave 2004

Wave 2004	A	B	C	D	Total
Cooperation rate	79.30	79.80	80.17	82.71	80.50
Contact rate	95.21	95.23	94.31	94.67	94.85
Response rate	75.50	75.99	75.61	78.31	76.35

TABLE 4 (b)

EU-SILC cross-sectional and longitudinal samples: synthetic quality indicators – wave 2005

Wave 2004	B	C	D	E	Total
Cooperation rate	87.00	87.97	86.89	82.61	85.91
Contact rate	97.44	97.35	97.22	95.71	96.85
Response rate	84.77	85.63	84.47	79.06	83.21

Briefly, it proves as a household that has already been in the sample is more likely to be contacted again and, most importantly, it is much more willing to respond than a new household selected for the first time. In such a way, the degree of participation in the EU-SILC survey significantly differs according to whether or not the household has been a panel unit. In 2005, in the mentioned three sub-groups of panel units (B, C and D) roughly 85% of eligible households did answer the questionnaire, while in the sub-group of refreshed households (E) less than 80% participated in the survey[14].

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[13] In EU-SILC survey, three-forth is approximately the overlapping fraction of households between two consecutive waves. Therefore, in 2005, beyond a refreshed group of households, units to be interviewed are approximately three-forth of households forwarded from the previous wave according to the following rules plus the new split-off households where sample individuals may have moved to. Although related to only two waves, the attrition rate – as complement to one of the ratio between the successfully interviewed households on both the waves (2004 and 2005) and the successfully interviewed households in 2004 plus the households existing in 2005 but do not answer the questionnaire – is roughly 13%. However, since individuals rather than households are the true longitudinal units in a panel, so-defined attrition rate is a slight approximation of the degree of success in interviewing the same set of households over the two EU-SILC waves.

[14] Being a contact with the household a basic condition to the EU-SILC participation, the interviewers' handbook stresses the importance to make three call attempts at least at different times of the day and/or different days of the week. Indeed, with regard to both the waves, roughly 90% of

Counting all initial sampling units in the response rate (that is the total units in sample, eligible and ineligible households and units of unknown eligibility), a more conservative quality measure, called *Completion rate* (Kviz, 1977), is obtained to verify both the frame and data collection procedure. Since ineligible units are also considered, cross-sectional completion rates (75.86% and 82.25% for 2004 and 2005, respectively) are slightly lower than the previous response rates, allowing to evaluate the incidence of out-of-scope households and their impact in terms of data quality. Closely related to the response rate and also useful for planning, scheduling and budgeting field operations, the completion rate indicates the proportion of successfully interviews obtained from the whole sample. In such a way, it is also a useful guide to decide how many sampling units might be selected to obtain a given number of successfully interviews from a particular population[15].

Although households are the basic units of sampling, data on income and several other topics are also acquired at individual level and, when members are temporarily not-at-home, information are collected by a proxy respondent. Therefore, the overall response rate at *individual* level, as ratio of successfully interviewed individuals to eligible household members, is equal to 78.80% and 85.80% in the two waves, respectively. Perfectly coherent with the overall response rate at household level (table 4), its increasing pattern denotes a gradual enhancement of actual survey participation over waves. Nevertheless, considering the proxy respondents, whose incidence is equal to 16.36% and 16.48% in the two waves, the overall response rate at individual level net of proxy responses significantly decreases – to 65.91% and 71.66%, respectively – even though, on both the waves, around 20% of proxy responses has directly been "verified" with the designated person.

6. DOES TOTAL NON-PARTICIPATION DIFFER ACROSS NATIONAL TERRITORY?

Since the EU-SILC survey is inherent in socio-economic events, we should expect that its participation levels might be affected, what's more, by some territorial characteristics. In other words, the social, economic and demographic context of potential respondents may be a significant factor of non-response process. Previous empirical analysis have also identified some cultural and sub-cultural variations in response rates (Eaton *et al.*, 1992; de Leeuw, 1999), while other studies have provided frameworks for understanding the mechanisms by which the

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respondent households needed a number of visits not more than three before the final interview. Therefore, the incidence of households with a number of visits more than four may be considered as marginal, being consistently less than 4%; any information about the number of visits was neglected by interviewers for the residual share of respondent households. Briefly, the average of the distribution of respondent households by number of visits before the final interview is equal to 1.60 (2004) and 1.56 (2005), respectively, while the mode is one visit on both the waves.

[15] In 2004, a residual number of questionnaires was rejected after that the validation procedure was completed. Since the rate of non-accepted interviews for database (ratio between rejected questionnaires and successfully interviewed units) is 0.27, the actually accepted interviews are equal to 75.66% of the initial sample size. In 2005, there isn't any share of rejected questionnaires.

socio-economic background may influence the survey behavior (Groves and Couper, 1998; de Heer, 1999). Really, beyond the national level, the context may also affects the choice to participate in a survey at a higher degree of territorial disaggregation where a variety of exogenous factors may occur.

As explained earlier, in this analysis we discern two sources of overall non-response, operating at two different hierarchical levels, and then we categorize them as non-contacts and non-cooperation. After that the corresponding quality indicators have been broken down by NUTS2 Italian regions, in order to investigate the territorial perspective, its role and significance, and the effects on total non-response process, a "null" model has been adopted. In the sphere of a "multilevel" conceptual framework, it is viewed as a one-way random effects ANOVA model where the dependent variable – separately, some previous quality indicators – is expressed as a linear combination of more components (Iversen and Norpoth, 1987; Jackson and Brashers, 1994; Singer, 1998). It enables to explore the influences on survey participation at a macro level and their impacts in terms of different trends across national territory as well.

Let Y_{ij} be a quality indicator, referring to i_{th} municipality (PSU) belonging to the j_{th} region, the null model states that Y_{ij} is equal to the overall mean of the quality indicator, μ, plus the effect of being in the j_{th} region, u_j, plus the residual effect associated with the i_{th} municipality in the j_{th} region, r_{ij}. In other words, the distance between the real value of the quality indicator and the overall mean, μ, is equal to u_j, measuring the effect of belonging to the j_{th} region, plus a residual, r_{ij}, representing the difference between the i_{th} municipality and the mean within the j_{th} region. The model has one fixed effect, which contains the single effect, μ, for the overall intercept, and a random part, which contains two random effects for the intercept, u_j, and for the within-region residual, r_{ij}, respectively. Both u_j and r_{ij} form a normal distribution with mean zero and variance equal to τ^2 and σ^2, respectively; the former denotes the variation among NUTS2 region means, the latter the variation among quality indicators within NUTS2 regions. Finally, in the null model, the intraclass correlation coefficient (ϱ), as ratio between τ^2 and the overall variance ($\tau^2 + \sigma^2$), measures the degree of homogeneity within groups and, consequently, the portion of total variance occurs between regions. Therefore, it reflects how regions differ in their rate average performance.

Defining as dependent variable, separately, the non-contact, non-cooperation and overall non-response rates, each of them is the complement to one of the previous synthetic quality indicators (table 4), a null model is estimated for each dependent variable, considering the NUTS2 regions as explanatory variable[16]. Main results, which inspect differences among contact, cooperation and overall response levels across national territory, are illustrated side-by-side in the table 5.

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[16] The variable NUTS2 regions is composed of 21 categories which correspond to 20 Italian regions – Piedmont, Aosta Valley, Liguria and Lombardy (North-West); Trentino-South Tyrol, Veneto, Friuli-Venezia Giulia and Emilia Romagna (North-East); Tuscany, Umbria, Marche and Lazio (Center); Abruzzo, Molise, Campania, Apulia, Basilicata and Calabria (South); Sicily and Sardinia (Islands) – and considering the sub-division of the Trentino-South Tyrol into the two autonomous provinces of Trent and Bolzano.

In the wave 2004, as regards to non-contacts and overall non-responses, the *region* variances (.0006 and .0062) are statistically significant with intraclass correlations, or region effects, equal to 0.1463 and 0.1157, respectively. On the other hand, looking at the non-cooperation, the region variance is not statistically significant; it means that Italian regions, even though significantly differ in contacts, do not differ in cooperation levels. However, the overall response does differ by Italian regions since nearly 12% of variance is at regional level. Similar trends are revealed for non-contacts and overall non-responses in the later wave 2005 with higher performance levels expressed by a region effect equal to 0.2059 and 0.1471, respectively. Moreover, it is interesting to note that the region variance becomes statistically significant for the non-cooperation rates, too; in 2005, for the survey cooperation, more than 13% of variance is at regional level, expressing a significant difference across Italian territory.

TABLE 5 (a)

Null model for non-contact, non-cooperation and non-response rates: solutions for fixed and random effects – 2004

Outcome rate	Non-contact	Non-cooperation	Non-response
Fixed effect:			
Intercept	0.0373 (.00340)	0.1575 (.00812)	0.1882 (.00880)
Variance components:			
Region variance	0.0006 (.00009)	0.0004 (.00039)^{ns}	0.0062 (.00053)
Residual variance	0.0035 (.00018)	0.0463 (.00240)	0.0474 (.00247)

* Standard errors in parenthesis

TABLE 5 (b)

Null model for non-contact, non-cooperation and non-response rates: solutions for fixed and random effects – 2005

Outcome rate	Non-contact	Non-cooperation	Non-response
Fixed effect:			
Intercept	0.0207 (.00322)	0.1448 (.01308)	0.1627 (.01366)
Variance components:			
Region variance	0.0007 (.00008)	0.0085 (.00107)	0.0098 (.00122)
Residual variance	0.0027 (.00013)	0.0558 (.00265)	0.0568 (.00270)

* Standard errors in parenthesis

Since frame errors and decisive refusals form a substantial component of non-contact and non-cooperation levels, respectively (*cfr.* § 4 and 5), in order to investigate the non-response process across national territory in more detail, they have also been considered in the null model. Finally, the same model has also been estimated with respect to completion rate; designating the proportion of successfully interviews obtained from the whole sample, it allows to reflect how regions differ in their average performance taken as a whole (table 6).

In 2004, Italian regions significantly differ in refusals and, even though at a vaguely lower degree, in frame errors. Indeed, the region variances (.0011 and .0005, respectively) are statistically significant, corresponding to a region effect more than 13% and 15%. Coherently to the overall non-response, the non-completion rate does differ by Italian regions since more than 13% of variance is at NUTS2 level. Although with higher performance levels, similar trends are sketched for the frame error and non-completion rates in 2005, expressed by a region effect slightly higher than 20% and 16%, respectively. In 2005, a lower region effect, statistically significant, is revealed for refusal rates with an intraclass correlation close to 5%.

TABLE 6 (a)

Null model for frame error, refusal and non-completion rates: solutions for fixed and random effects – 2004

Outcome rate	Frame error	Refusal	Non-completion
Fixed effect:			
Intercept	0.0348 (.00317)	0.0625 (.00463)	0.1925 (.00900)
Variance components:			
Region variance	0.0005 (.00008)	0.0011 (.00013)	0.0071 (.00056)
Residual variance	0.0031 (.00016)	0.0061 (.00032)	0.0470 (.00245)

* Standard errors in parenthesis

TABLE 6 (b)

Null model for fram error, refusal and non-completion rates: solutions for fixed and random effects – 2005

Outcome rate	Frame error	Refusal	Non-competion
Fixed effect:	0.0247 (.00315)	0.0740 (.00668)	0.1703 (.01373)
Intercept			
Variance components:			
Region variance	0.0006 (.00008)	0.0012 (.00027)	0.0113 (.00123)
Residual variance	0.0024 (.00011)	0.0243 (.00116)	0.0564 (.00269)

* Standard errors in parenthesis

Briefly, Italian regions significantly differ in non-contact, overall non-response and, obviously, non-completion rates on both the waves, while non-cooperation levels seem to be statistically different across national territory only in 2005. At the same time, a more detailed analysis highlights how these differentials across Italian regions also concern the two crucial sources of non-contacts and non-cooperation, namely frame errors and refusals. However, a downward trend over the two waves is sketched for the outcome quality rates considered in the analysis, also due to the panel framework of the EU-SILC survey.

7. PREDICTING THE SURVEY PARTICIPATION

In order to evaluate how the participation in EU-SILC survey is affected by the background context, multinomial logistic models are estimated by a set of territorial attributes; at this end, the two sources of overall non-response – non-contact and non-cooperation – operating at two different hierarchical levels are separately considered. Indeed, as shown by Groves and Couper (1998), refusal, as the main source of non-cooperation, and non-contact processes are quite different although, in practice, there may be some overlap in their predictors[17].

Let Y_i be the outcome variable referring to the i_{th} eligible household which is coded 0 if it has been successfully interviewed, 1 if it has not been contacted, setting aside all potential reasons, and 2 if the i_{th} household has not cooperated despite it has successfully been contacted. Taking participation (successfully interviewed households) as reference category, response probabilities are function of the vector of $2(p+1)$ parameters $\beta' = (\beta_1', \beta_2')$ denoted by:

[17] A multinomial logistic model allows to evaluate simultaneously the effects of territorial factors on the probability of non-contact and non-cooperation and to test for differences or similarities in the potential determinants of the two sources of overall non-response.

$$\pi_j(x) = P(Y = j \mid x) = \frac{e^{g_j(x)}}{\sum_{k=0}^{2} e^{g_k(x)}} \qquad \text{for j = 0, 1, 2} \tag{1}$$

where:

$$g_j(x) = \ln\left[\frac{P(Y = j \mid x)}{P(Y = 0 \mid x)}\right] = \beta_{j0} + \beta_{j1}x_1 + \beta_{j2}x_2 + ... + \beta_{jp}x_p + \varepsilon_j = x'\beta_j + \varepsilon_j \tag{2}$$

The adopted multinomial model consists of two simultaneous equations. The first one (j=1) models the probability of non-contact versus participation as a function of a set of contextual covariates; similarly, the second one (j=2) models the probability of non-cooperation versus participation. Exogenous information (covariates) about the municipality where the household is located come from the Istat databases of territorial indicators, covering a variety of subject-matter areas with a lot of time-series spatial indicators, some of them available at a high degree of territorial disaggregation. However, if a territorial indicator is not available at a municipality level, the corresponding indicator at provincial level (NUTS3) is used. Since these territorial rates are considered as measures of levels, they may be used as indicators of economic, demographic and social disparities across Italian territory. For their selection, the correlation matrix between all possible covariates is explored and their degree of association with each one of synthetic quality indicators (*cfr.* § 5) is evaluated. In order to avoid multicollinearity, in case of strongly correlated covariates, conditions being equal, the ones with a higher level of correlation with the synthetic quality indicator are selected according to a stepwise procedure (Hosmer and Lemeshow, 2000).

Firstly, the analysis underlines a high level of negative correlation between activity rate and unemployment rate, on the one hand, and employment and unemployment rates, on the other one. Although consistently significant, the correlation degree between the activity and unemployment rates is lower than the other one and that justifies the choice in considering the two indicators in the multinomial model jointly or, alternatively, the employment rate by itself when it is able to explain a higher variability of outcome variable. In addition to the gross domestic product, the activity, employment and unemployment rates make up the set of *economic* attributes. Briefly, these variables are correlated with each other, but not correlated to the extend that they measure the same.

Secondly, since a high level of significant concordance among the indicators reflecting the territorial distribution of population is detected, especially between the resident population per 100 inhabitants and the index of territorial concentration of resident population, the one with the higher level of explicative power of variability of outcome variable is just selected. In addition to the net migratory and crude death rates, the resident population per 100 inhabitants, the index of territorial concentration of resident population and the population density represent the set of *demographic* attributes.

Thirdly, there is a high level of significant positive correlation between the net migratory rate and gross domestic product, on the one side, and the legal separa-

tion rate and divorce rate, on the other one. In those cases, the covariates are mutually exclusive for the multinomial model. The correlation between the other covariates is rather small and sometimes with a low significance level. The legal separation and divorce rates, along with the crime rate and suicides per 100.000 inhabitants, constitute the set of *social* attributes.

Finally, since the one-way random effects ANOVA model highlights that Italian NUTS2 regions significantly differ in non-contact on both the waves and in non-cooperation levels at least in 2005, in order to explore the territorial contribution to overall non-response, a qualitative variable reflecting the geographical localization of different Italian municipalities (PSUs) is also considered. Really, to make things simpler, the national macro areas (NUTS1 level) – the North-East, the North-West, the Center, the South and the Islands – are just considered rather than each single NUTS2 region. In such a way, following a binary coding, a set of four dummy variables is constructed so that each household is coded 1 if it belongs to a particular geographical area and 0 otherwise, adopting the South of Italy as reference group.

7.1. *EU-SILC response probability: some empirical evidence*

The main evidence of multinomial models, which predict the probabilities of non-contact and non-cooperation versus the participation in EU-SILC survey by territorial factors, are presented side-by-side in the following table[18].

TABLE 7 (a)

Multinomial logistic model: non-contact and non-cooperation vs participation – wave 2004

Independent variables	Non-contact		Non-cooperation	
Intercept	- 1.3965***	(.5745)	- 2.7726**	(1.4001)
Economic variables:				
Activity rate	0.0117^{ns}	(.0239)	0.0008^{ns}	(.0032)
Unemployment rate	- 0.0023^{ns}	(.0329)	- 0.0074^{ns}	(.0514)
Demographic variables:				
Resident population per 100 inhabitants	0.1345***	(.0352)	0.0278*	(.0016)
Net migratory rate	0.0678**	(.0338)	0.0004**	(.0002)
Crude death rate	0.0442**	(.0186)	0.0244^{ns}	(.0232)
Social variables:				
Crime rate	0.1552***	(.0375)	0.0554**	(.0281)
Legal separation rate	0.0823***	(.0224)	0.0982***	(.0359)
Geographical localization:				
North-East	0.0116***	(.0042)	0.0034^{ns}	(.0031)
North-West	0.0119***	(.0042)	0.0039^{ns}	(.0042)
Center	0.0149***	(.0032)	0.0042*	(.0024)
Islands	0.0097**	(.0049)	0.0029^{ns}	(.0032)
Log likelihood	- 165.25		- 253.15	

* Robust standard errors in parenthesis
* Significance levels: ***1%; **5%; *10%

[18] The statistical significance of each covariate has been assessed by the Wald test which compares the maximum likelihood estimate of each β to its standard error; under the null hypothesis that β=0, this ratio follows a standard normal distribution (Hosmer and Lemeshow 1989). In this work, multinomial models are estimated using the household as unit of observation, while all covariates are measured at the area level. The consequence is likely to be standard errors that are biased downward due to the possibility that the random disturbances are correlated within groups, which can result in spurious findings of statistical significance for the aggregate variables. To avoid this problem, robust standard errors are estimated with the adjustment procedure by Moulton (1990).

TABLE 7 (b)

Multinomial logistic model: non-contact and non-cooperation vs participation – wave 2005

Independent variables	Non-contact		Non-cooperation	
Intercept	- 3.0010***	(.4548)	- 1.7548***	(.3485)
Economic variables:				
Activity rate	0.0469**	(.0239)	0.0820**	(.0412)
Unemployment rate	- 0.0199^{ns}	(.0319)	- 0.0712**	(.0361)
Demographic variables:				
Resident population per 100 inhabitants	0.0851***	(.0329)	0.1148***	(.0412)
Net migratory rate	0.0661**	(.0329)	0.0631**	(.0311)
Crude death rate	0.0001^{ns}	(.0008)	0.1058^{ns}	(.0741)
Social variables:				
Crime rate	0.0900***	(.0348)	0.0963***	(.0347)
Legal separation rate	0.0412*	(.0250)	0.3011*	(.1702)
Geographical localization:				
North-East	0.0103**	(.0049)	0.0142*	(.0081)
North-West	0.0147***	(.0056)	0.0179**	(.0090)
Center	0.0202***	(.0073)	0.0151***	(.0058)
Islands	0.0123***	(.0042)	0.0097*	(.0057)
Log likelihood	- 175.85		- 278.12	

* Robust standard errors in parenthesis

* Significance levels: ***1%; **5%; *10%

In relation to non-contacts versus participation, the most significant demographic covariates tend to be the resident population per 100 inhabitants and the net migratory rate on both the waves; the crude death rate on the first wave only. Similar results are detected as regards to non-cooperation versus participation: the net migratory rate preserves the high level of significance on both the waves and the resident population per 100 inhabitants especially for 2005; conversely, the crude death rate is never statistically significant. It is interesting to note that all statistically significant demographic attributes above illustrated show the same positive sign, denoting a direct effect on the probability of non-contact and non-cooperation and, consequently, a negative impact on the probability of participation in EU-SILC survey. Our results partly support those of previous empirical studies. Goyder *et al.* (1992) and Groves and Couper (1998) highlight as residents of densely populated areas are less likely to accede to an interviewer's request to participate in a survey and House and Wolf (1978) discover a slight, although significant, correlation between population density and refusal rates. Moreover, in the second step of the sampling weight procedure concerning the overall non-response adjustment in EU-SILC survey, Ceccarelli and Cutillo (2006) identify a set of variables as to which a differential total response rate is observed. In particular, they demonstrate how the difficulty to response increases with the increasing the demographic size of municipalities and how a lower probability to participate in the EU-SILC survey is revealed by those units with the head of household foreign due to their high mobility through the national territory as well as their difficulty or mistrust towards interviewers. As explained by Bank of Italy (2008), fewer difficulties may be encounter with households residing in small towns.

Moreover, there are relatively large differences among Italian NUTS2 regions both in non-contact and non-cooperation rates, taken as a whole. In particular, it is worth to note that, except for Veneto (both the waves) and Umbria (2004), the

southern regions (*i.e.*, Basilicata, Molise, Sardinia, Apulia, Calabria and Campania) show a higher participation in EU-SILC survey. In practice, analyzing sub-regional variations, the household participation appears to be more deficient in metropolitan municipalities[19]. Coherently with several other household sample surveys, the overall participation in EU-SILC survey is perceptively lower than the national average in some Italian regions where the larger municipalities are located – *i.e.*, Lazio (Rome), Friuli-Venezia Giulia (Trieste), Liguria (Genoa), Piedmont (Turin) and Lombardy (Milan). However, despite the location of a metropolitan area, some other regions keep a higher levels of participation – *i.e.*, Sicily (Palermo, that is the metropolitan municipality with the highest overall non-response rate; Catania and Messina) and Campania (Naples, that keeps a medium total non-response rate).

According to Goyder (1987) theory, lower socio-economic groups would be less likely to respond to a survey request; therefore, the socio-economic context may also be regarded as a further indicator of likelihood of survey participation. In this light, the crime rate is consistently statistically significant, on both the waves, in relation to non-contacts as well as non-cooperation versus participation. As they say, the fear of violence, felonies and offences may be a barrier to avoid any contact with strangers or, although a household has been successfully contacted, a deterrent to willingness to be interviewed. Coherently with the literature (House and Wolf, 1978; Parker and Ray, 1990), it is worth to note that the crowding, as a high degree of concentration of population in the same area, and the high levels of criminality, that involves fear and reluctance to interact with strangers, along with the legal separation rate, have a great predictive power of the probabilities of non-contacts and non-cooperation. From a strictly economic point of view, our findings appear to validate partially the Goyder theory since the activity rate, measuring the incidence of the labor force to the population aged 15 or over, is statistically significant in relation to non-contacts and non-cooperation versus participation only for 2005, whereas the unemployment rate, assessing the incidence of seeking employment individuals to the labor force, appears to predict only the cooperation levels, at least for 2005.

Finally, as regards to non-contacts, on both the waves, and non-cooperation, on the second one, differences among the coefficients of dummy variables are not so large but always statistically significant; as regards to non-cooperation versus participation, dummy variables are not statistically significant for 2004. Coefficients of dummy variables allow to evaluate, on average, the distance between the probabilities of non-contact or non-cooperation versus participation of households located in the southern municipalities and those ones of other Italian municipalities, net of effects of other covariates. In other words, for each household these coefficients assess the effect of being in a particular geographical area

[19] In Italy, 14 metropolitan municipalities are counted: Rome (Lazio), Milan (Lombardy), Naples (Campania), Turin (Piedmont), Palermo (Sicily) and Genoa (Liguria), with more than 500.000 inhabitants; Bologna (Emilia Romagna), Florence (Tuscany), Bari (Apulia), Catania, Messina (Sicily), Venice and Verona (Veneto), with more than 250.000 inhabitants but less than 500.000; and, finally, Trieste (Friuli-Venezia Giulia).

in comparison with the reference category (the South). As they say, the location of a household in a municipality in the North-West or Center of Italy rather than the South has a negative effect on the survey participation. Indeed, from an overall view, by contrasting the estimated coefficients of dummy variables, it is possible to note a decreasing distribution, in absolute values, of these coefficients as one moves from the Center and North-West to the Islands and North-East. These findings substantially validate those of the previous section where we stress how Italian NUTS2 regions significantly differ in non-contacts on both the years and in non-cooperation on the second wave only.

8. CONCLUDING REMARKS AND FURTHER DEVELOPMENTS

With focus on the several components of total non-response error, empirical findings of our analysis emphasize some critical features in the quality of EU-SILC data production process and, most importantly, how the performance, in terms of overall participation in the survey, differs across national territory. However, the overall response rates of the Italian section of EU-SILC survey appear to be consistently higher than the European average. Since the survey is inherent in socio-economic events, this condition offers the chance to verify how the participation degree is affected by background characteristics also at a sub-regional level. In this light, our analysis points out a variety of demographic, social and economic attributes as to which a differential probability of non-contact and non-cooperation, as the two main sources of non-participation, has been observed across national territory. In particular, total non-response rates in large urban areas, densely populated, often with higher levels of criminality and violence and, sometimes, with a larger presence of foreigners, seem to be perceptively higher than the national average. As they say, the crowding, as a high degree of concentration of population in the same area, and the high level of criminality, that involves fear and reluctance to interact with strangers, along with different levels of unemployment, may be a barrier to avoid any contact with strangers or, although a household has been successfully contacted, a deterrent to willingness to be interviewed. Since these factors have a great predictive power of non-contact and non-cooperation, they may be considered as potential determinants of the probability of non-participation in EU-SILC survey.

Coherently with several other household sample surveys, the analysis emphasizes how the overall non-response rate in some Italian regions (where the larger municipalities are located) is perceptively higher than the national average, although some other regions keep higher performance despite the location of a metropolitan area. Analyzing sub-national variations, it is worth to note that non-cooperation rates seem to be statistically different across national territory only in 2005, although non-contact, overall non-response and, obviously, non-completion rates significantly differ by Italian NUTS2 regions on both the waves. Differentials across these regions also concern the frame errors and refusals as the two crucial sources of non-contacts and non-cooperation, respectively. In this

light, an optimistic downward trend over the two waves is sketched for the outcome quality indicators considered, also due to the panel framework of EU-SILC survey; however, we do not attempt to draw any conclusion about aggregate trends from differences based on a single pair of years. Briefly, except for Veneto (North-East) and, only in 2004, Umbria (Center), the southern regions show a higher degree of participation in EU-SILC survey.

Furthermore, beyond the territorial factors, a variety of household-level variables may strongly influence the survey participation, such as the socio-economic status, the head of household's income and educational qualification, the age and marital status, the number of household members, and so on. Also the fieldwork characteristics or the municipal administration system may have, among other things, some impact on the regional variations of non-response; in particular, if some interviewers do a better job in some regions, this could explain the regional differences as well. Unfortunately, household-level data and other socio-demographic characteristics of interviewees and interviewers, which are likely to be important for explaining survey participation, are not available for the most non-respondents. The unavailability of this auxiliary information prevents us from estimating the impact of total non-response on bias and variance estimation even for the target variables (*i.e.*, risk-of-poverty rate, annual average individual income for the cross-sectional component, and at-persistent-risk-of-poverty rate for the longitudinal sections).

As the EU-SILC survey design for Italian segment is based on four-year rotational panels for households, we intend to complement the analysis to cover the more recent issues of the survey or, at least, the 2006 and 2007 waves which allow to obtain the first complete longitudinal sample of maximum duration of four years. In such a way, some more conclusions about aggregate trends may be drawn. Moreover, being EU-SILC an international project, it could be interesting to extend the analysis to all other countries involved since dissimilar patterns of unit non-response are depicted across countries with a noteworthy impact on data quality and comparability. However, in that case, differences in the EU-SILC design among countries, alternative procedures of data collection and even different approaches to measurement have to be seriously considered.

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SUMMARY

The impact of territorial factors on the total non-response error in the European Union – Survey on Income and Living Condition (EU-SILC)

This paper discusses a framework for the evaluation of accuracy of the Italian section of EU-SILC data with focus on non-sampling errors related to several components of the total non-response at household level. Following a classical hierarchical approach, classes of quality indicators are obtained by aggregating some ad hoc basic quality rates. Subsequently, in order to investigate the territorial perspective and its effects on the total non-response, one-way random effects ANOVA model and a multinomial logistic regression model are estimated. In this light, the work aims at exploring the main demographic and socio-economic factors potentially correlated with the survey participation at a sub-national level. The final goal is sketching a territorial quality profile to identify those crucial areas with a more difficulty to be interviewed in order to define some ad hoc corrective interventions.