How to measure income components: General perspective and the choices of Italy

Paolo Consolini – Istat

The World Bank C4D2 Training: *Measuring Income and Wealth through Household Surveys for Welfare Monitoring* - December 10-14, 2018 - Perugia

Istat

Presentation Overview

- Sources of household income statistics, data analysis and collection units, reference period, source of errors
- The choices of Italy: sample design, multisource data collection, errors correction process
- Joint use of survey and administrative data together: Why? What benefits?
- An outline of main It-Silc process phases, managing new administrative sources, critical factors, mapping
- Scheme of the micro-data integration process: data processing operations, requirements, classification and solution to inconsistencies, values reconciliation
- Concluding remarks and future developments

Sources of household/personal income statistics

- Most income distribution statistics rely on data collected in household surveys
- Some countries (i.e. Nordic Countries and Canada) use administrative data to this scope (Register-based statistics)
- Some income components are imputed by model (i.e. personal tax, social contribution, imputed rent)

Survey income statistics

- Income data are usually collected through sample surveys (designed household income surveys or multi-topic surveys)
- Household surveys generally collect information from usual residents of private dwellings
- The design of the sample is based on appropriate sampling techniques in order to obtain a fixed statistical precision
- The mode of data collection in household surveys may vary: usually face-to-face interview is applied (occasionally telephonic) together with Computer-assisted technique

Register-Based Statistics (RBS) on income

- There is a legal basis to use it for statistical purposes, personal income data from registers
- RBS provide total or near total population coverage and can therefore be used to produce more detailed statistics for small areas or subgroups of population
- RBS allow lower respondent burden and are generally a less costly means of producing statistics
- RBS are not subject to sampling and non-response errors
- Nevertheless RBS could be not relevant for statistical purpose and present constrains for timely releasing

Measurement units

- It's important to distinguish between the data collection unit and the data analysis unit
- The first will depend on design of survey (households or dwellings) the second will depend on type of income (wages and salaries are best collected at the individual level whilst imputed rent should be collected at the household level)
- Private Household (EU-SILC): defined as a person living alone or a group of people who live together in the same private dwelling and share expenditures, including the joint provision of living essentials

Measurement units

Household member (EU-SILC)

Subject to the further and specific conditions shown below, the following persons must, if they **share household expenses**, be regarded as household members:

1. Persons usually resident, related to other members
2. Persons usually resident, not related to other members
3. Resident boarders, lodgers, tenants
4. Visitors
5. Live-in domestic servants, au-pairs
6. Persons usually resident, but temporarily absent from dwelling (for reasons of holiday travel, work, education or similar)
7. Children of the household who are being educated away from home
8. Persons absent for long periods, but having household ties: persons working away from home
9. Persons temporarily absent but having household ties: persons in hospital, nursing home, boarding school or other institution

Measurement units

Household member (EU-SILC)

Further conditions for inclusion as household members are as follows:

For categories (3) (4) (5):
Currently has no private address elsewhere or their actual or intended duration of stay is six months or more

For category (6):
Currently has no private address elsewhere and their actual or intended duration of stay is less than six months

For categories (7) and (8), irrespective of the actual or intended duration of absence, the person:
Currently has no private address elsewhere, is the partner or child of a household member, and continues to retain close ties with the household and considers this address to be his/her main residence

And for category (9):
The person has clear financial ties to the household and the actual or expected duration of absence from the household is less than six months

Reference period

The international standards state that household income statistics should relate to a full year to take into account seasonal variations in incomes. Annual income includes the income obtained from all sources over a period of a year.

Sources of errors (estimated value differs from true one)

Income distribution statistics are generally subject to two type of errors: non-sampling and sampling error

Sources of non-sampling error include:

- **non-response errors**
- errors in the frame of units sample (**list errors**)
- errors in reporting by respondents or recording of answers (**measurement errors**)
- errors in **coding** and **processing** the data

Non sampling errors

Table 3.2 Types of non-response

Problem	Description	Common solution
(1) Unit non-response	Failure to obtain any information on a sample household, including the household interview and personal interviews in the household	Weighting
(2) Partial unit non-response	Failure to obtain a personal interview with a subset of the eligible adults in a household	Weighting or full-case imputation
(3) Item non-response	Failure to obtain some target variables in an otherwise completed interview (this generally affects non-income variables in register countries and all – especially income – variables in survey countries).	Imputation for missing items
(4) Partial item non-response	Refers to the situation when some but not all the information is obtained on a target variable. The most important case is that of detailed income components: a part of the component may be missing, and/or conversion may be required from the collected net to the required gross amount.	Imputation for the missing part

Source: Verma and Betti, 2010

Non sampling errors

It's worth knowing:

- Non-response can affect the reliability of the results and can introduce a bias (= true – estimated value)
- The magnitude of this bias depends upon the level of non-response and the difference between the characteristics of people who responded to the survey and those who did not

Sampling errors

In general terms is a measure of the variability that occurs by chance because a sample, rather than the entire population, is surveyed

In statistical terms is the difference between a sample statistic used to estimate a population parameter and the actual but unknown value of the parameter

One measure of the likely difference is given by the standard error (SE). Another measure of the likely difference is the relative standard error (RSE => SE as a percentage of the estimate)

Strategies to reduce the sampling error: increase the sample size, improve the sample design (stratification)

EU-SILC: Italian choices (IT-SILC)

SILC is an output harmonized instrument

Degree of freedom in terms of:

- ✓ Data collection strategy: CAPI/CATI & Admin Data (multisource)
- ✓ Sampling: Two stages and 4 waves rotational sample design
- ✓ Questionnaire design: Contact-Register-Household-Individual Form
- ✓ Errors correction strategies: editing - imputation - calibration

IT-SILC Sampling design

Two stage sampling design:

- ✓ First stage units (PSU): the municipalities
- ✓ Second stage units (SSU): the households

PSU are stratified according to their demographic size (i.e. # residents)

Stratification is carried out inside each administrative region

PSU are selected in each stratum with probability proportional to their size (systematic sampling method by Madow,1949)

Secondary sampling units (i.e. households) are not stratified

Households are selected with equal probability by systematic sampling in each selected municipality from population register lists (LAC).

No substitution of unit non-response has been applied

IT-SILC Sample size

- the **actual sample size** which is the number of sampling units selected in the sample (8.000 - till 2010=> 10.000 – 14000 between 2014-2018)
- the **achieved sample size** which is the number of observed sampling units (household or individual) with an accepted interview (about 21.000 households and 41.500 individuals (16+))
- the **effective sample size** which is defined as the achieved sample size divided by the design effect with regards to the at-risk-of poverty rate indicator

The minimum effective sample size is 7.250 households (according to Eurostat). Being the sampling design effect about 2 (e.g. 2.1904 in 2011), the minimum sample of households to meet the requirements of the regulation is 15.880. We choose a larger sample size to provide reliable estimates at **regional level**

Questionnaire

- **Register form**
  - ✓ Individual information (sex, date of birth, country of birth, citizenship, marital status….)
  - ✓ Household members relationships (with reference person – 20 possible relationships)
  - ✓ Child-care target variables

Questionnaire

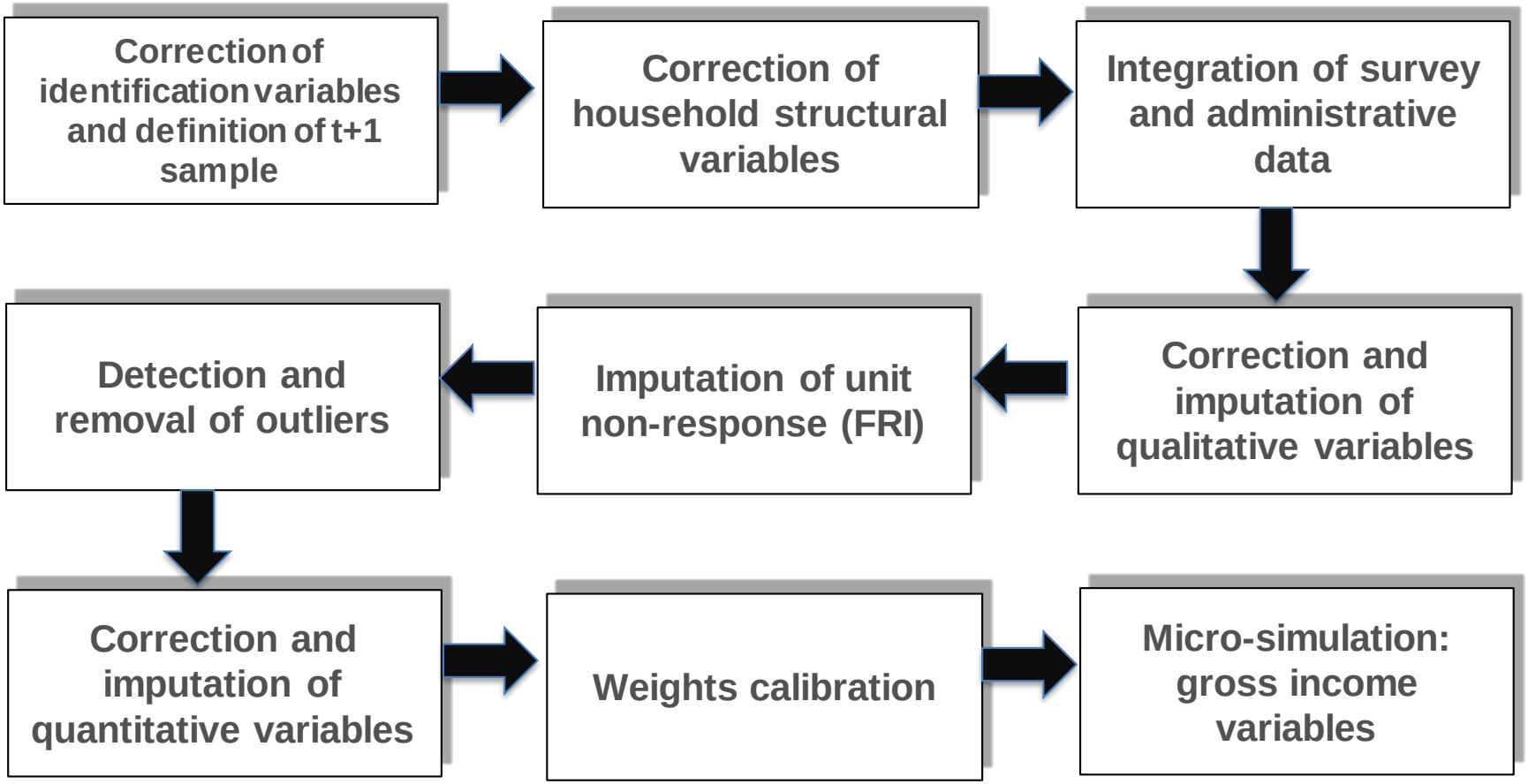
Household information

- ✓ Dwelling (dwelling characteristics and amenities, durables, utility bills and other costs….)
- ✓ Rented accommodation (tenant(s), rent costs…)
- ✓ Owned accommodation (owner(s), mortgage..)
- ✓ Economic situation (material deprivation items, household income, savings, support network…)
- ✓ Income of household members younger than 16
- ✓ Children economic situation (Child-specific material deprivation items, e.g. Two pairs of properly fitting shoes, One meal with meat, chicken or fish or vegetarian equivalent at least once a day)

Questionnaire

- **Individual information**
  - ✓ Education
  - ✓ Health
  - ✓ Employment (à la ILO)
  - ✓ Main Job characteristics
  - ✓ Previous job experience
  - ✓ calendar of activities (income reference year)
  - ✓ Income from dependent employment
  - ✓ Income from self-employment
  - ✓ Other job-related income
  - ✓ Pensions (from individual private plans & from foreign bodies)
  - ✓ Other income information (savings and rent from properties, alimonies and other private transfers)
  - ✓ Individual material deprivation (e.g. Spend a small amount of money each week on yourself, Replace worn-out clothes by some new ones)

The IT-SILC Scheme of Errors Correction Process



The EU-SILC gross income components

Total gross household income (HY010) is computed as:

The sum for all household members of gross personal income components

Gross employee cash or near cash income (PY010G),

Company car (PY021G),

Gross cash benefits or losses from self-employment (including royalties) (PY050G),

Pensions received from individual private plans (other than those covered under ESSPROS) (PY080G),

Unemployment benefits (PY090G),

Old-age benefits (PY100G),

Survivor' benefits (PY110G),

Sickness benefits (PY120G),

Disability benefits (PY130G),

Education-related allowances (PY140G);

Plus gross income components at household level

~~imputed rent (HY030G)~~,

Income from rental of a property or land (HY040G),

Family/children related allowances (HY050G),

Social exclusion not elsewhere classified (HY060G),

Housing allowances (HY070G),

Regular inter-household cash transfers received (HY080G),

The EU-SILC disposable household income

Total disposable household income (HY020) can be computed as:

The sum for all household members of gross personal income components

Gross employee cash or near cash income (PY010G),

Company car (PY021G),

Gross cash benefits or losses from self-employment (including royalties) (PY050G),

Pensions received from individual private plans (other than those covered under ESSPROS) (PY080G),

Unemployment benefits (PY090G),

Old-age benefits (PY100G),

Survivor' benefits (PY110G),

Sickness benefits (PY120G),

Disability benefits (PY130G),

Education-related allowances (PY140G);

Plus gross income components at household level

Minus
Regular taxes on wealth (HY120G),
Regular inter-household cash transfer paid (HY130G),
Tax on income and social insurance contributions (HY140G).

The choice of Italy
Multiple data collection strategy: Why? What benefits?

- **for data providers**: *lower* response burden
- **for producers**: Decreasing budgets, improving cost efficiency, sharing and building on good practice
- **from user's point of view**: *higher* data quality and *more detailed* information

The choice of Italy…….

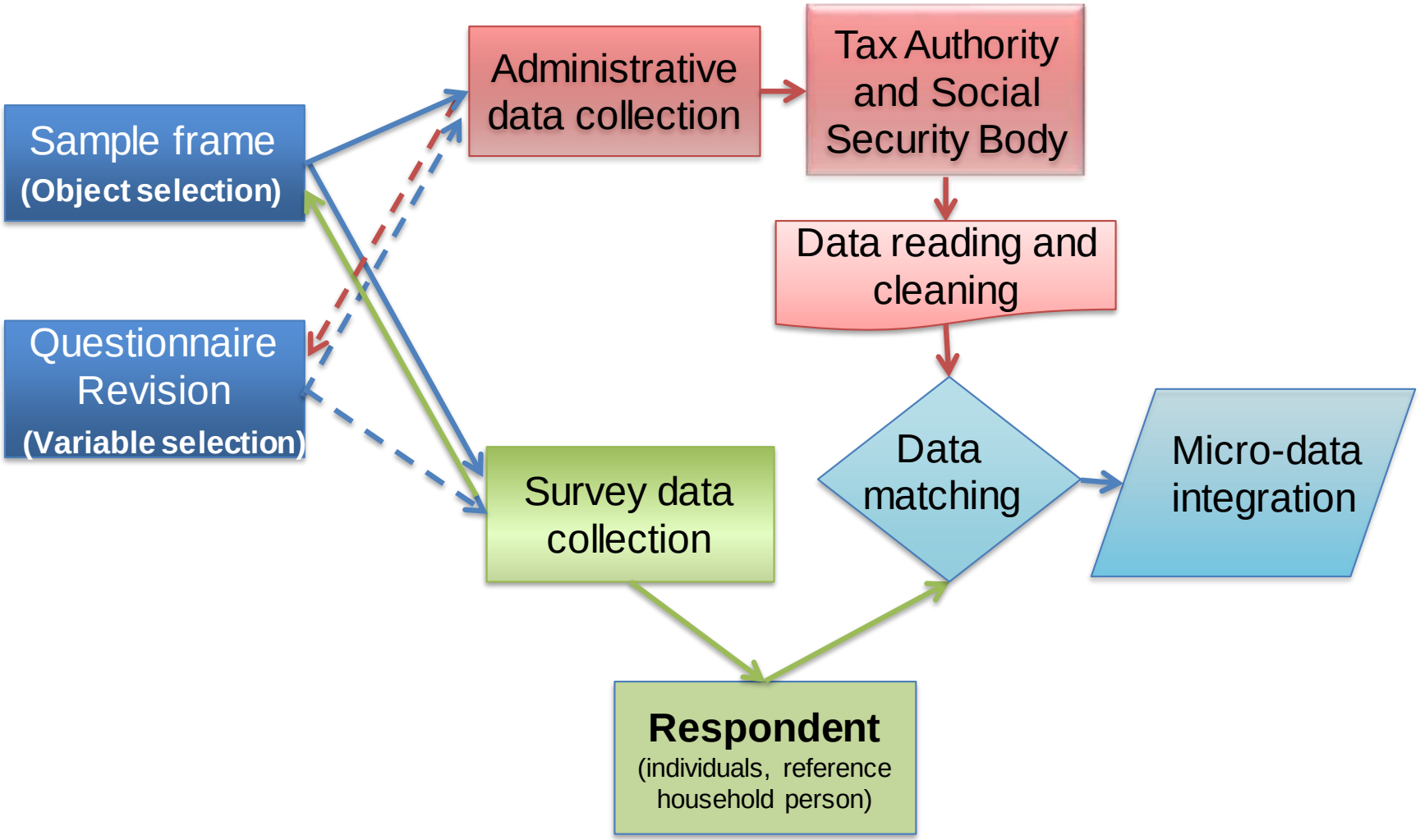
How is possible to combine administrative and survey data?

By selecting an individual “matching-key” able to link the same unit across different data-sources

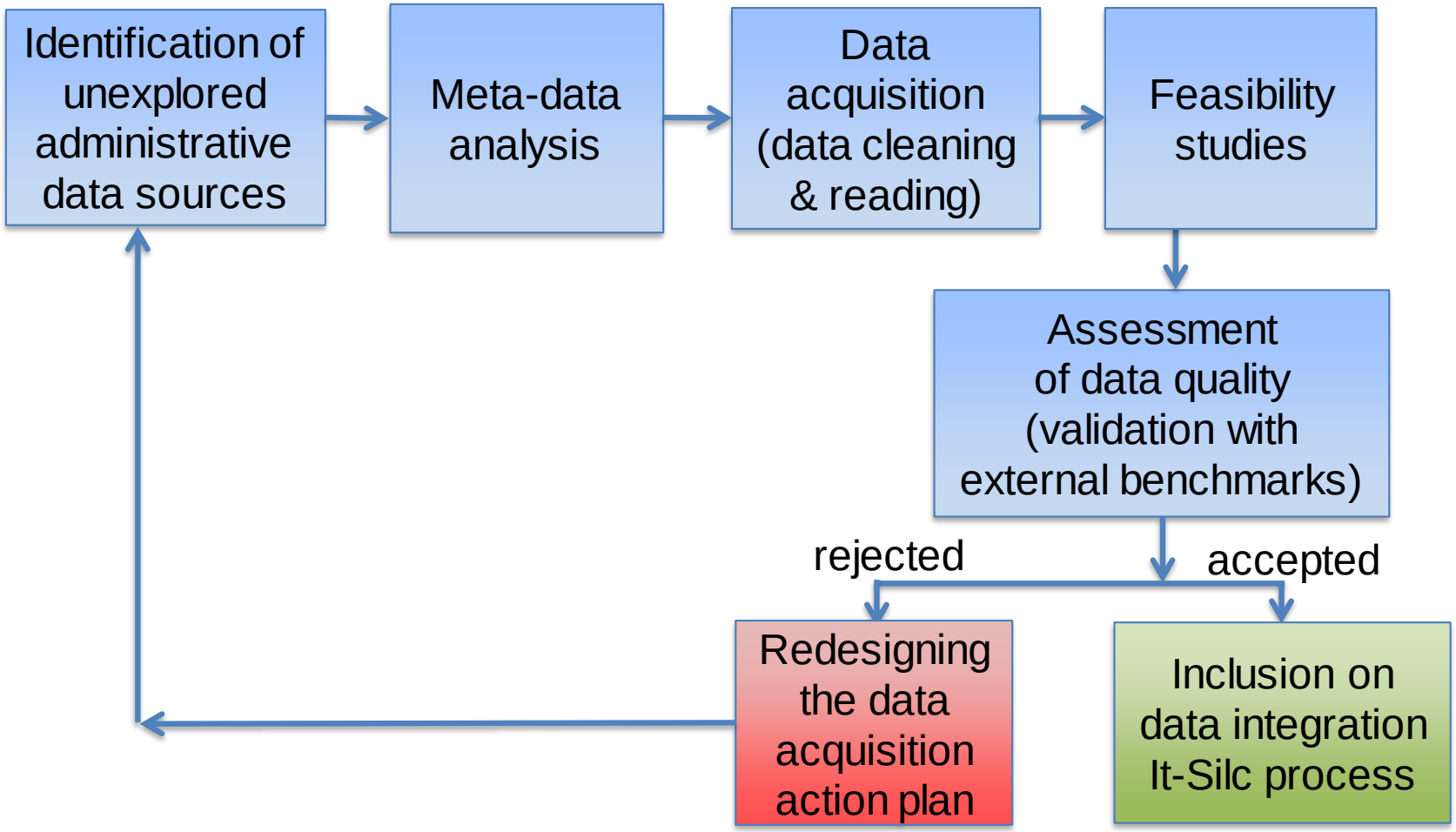
Which is the best “matching-key” to our scope?

The “tax number” (i.e. the personal identification number assigned to each person by the Italian Tax Authority)

Phases of IT-Silc multisource data collection process



A simplified scheme of the exploitation of new Admin sources



Critical factors to extensive use of administrative data

The adequacy of concepts, classifications, nomenclatures and variables of administrative data for statistical needs (relevance & harmonization)

The quality of the administrative data itself (coverage)

The access conditions and terms/times of transmission of administrative data

The stability of the administrative source and its contents (legislative changes)

IT Capacity of the NSI in the management of an Administrative Data Repository

Information security
Istat policy of protecting personal data

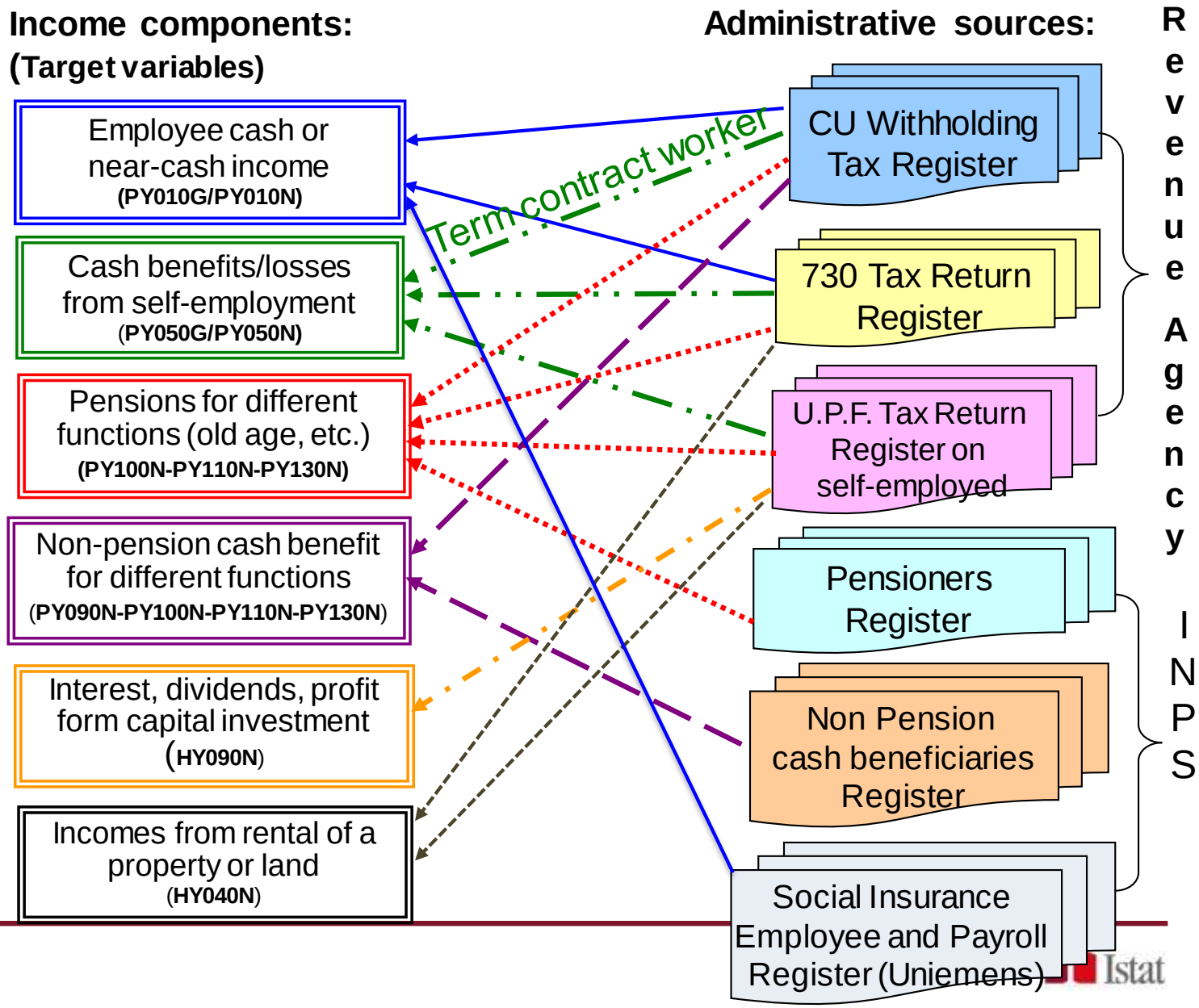
Authentication, authorization and accounting (AAA) system for tracking user activities on Istat Data Warehouse

Identifier elements need to be stored separately from the "research data"

All personal information will be destroyed once it is no longer needed for the statistical puprose

Protection of confidentiality in data dissemination (statistical disclosure control)

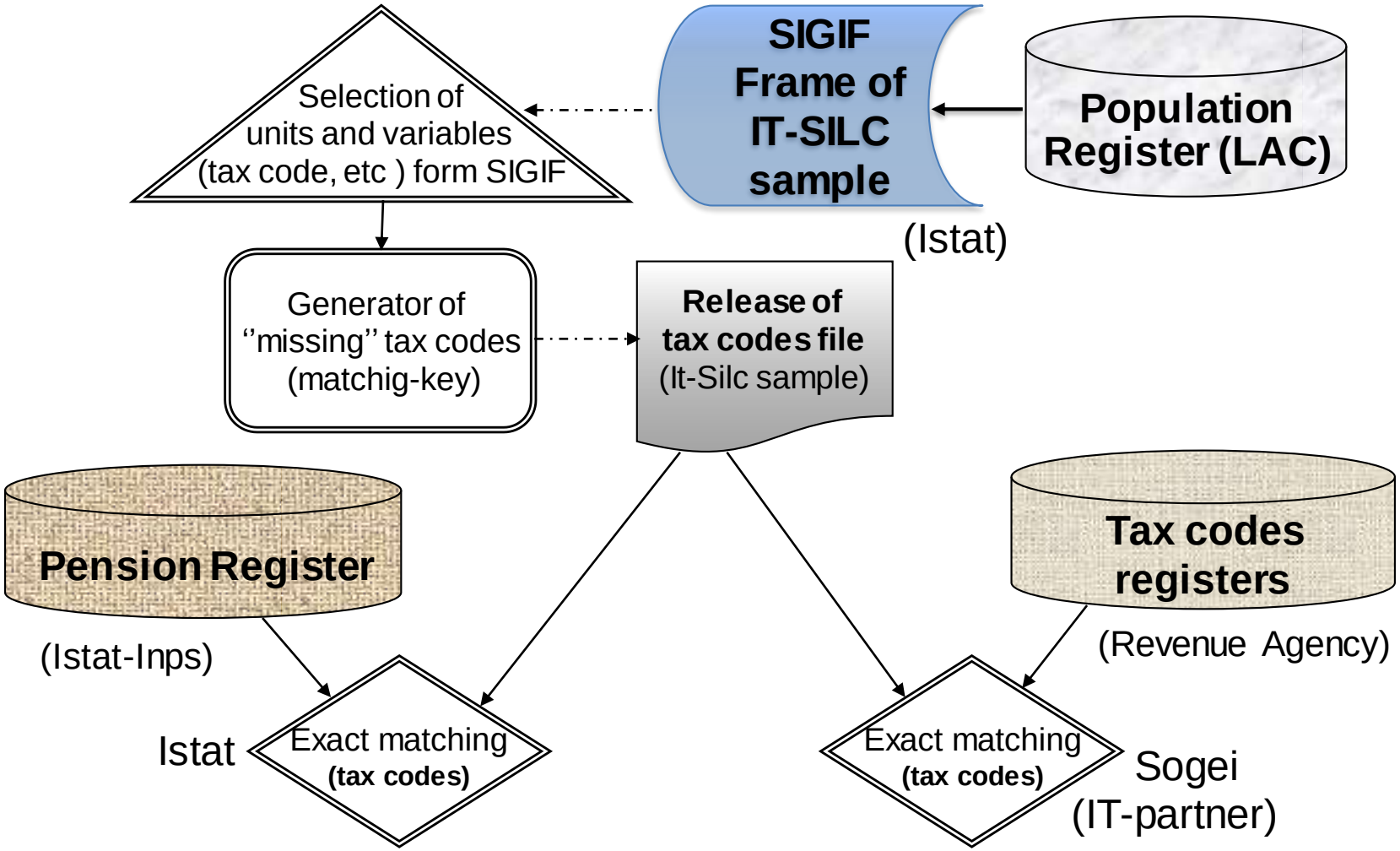
Mapping administrative sources for statistical purposes



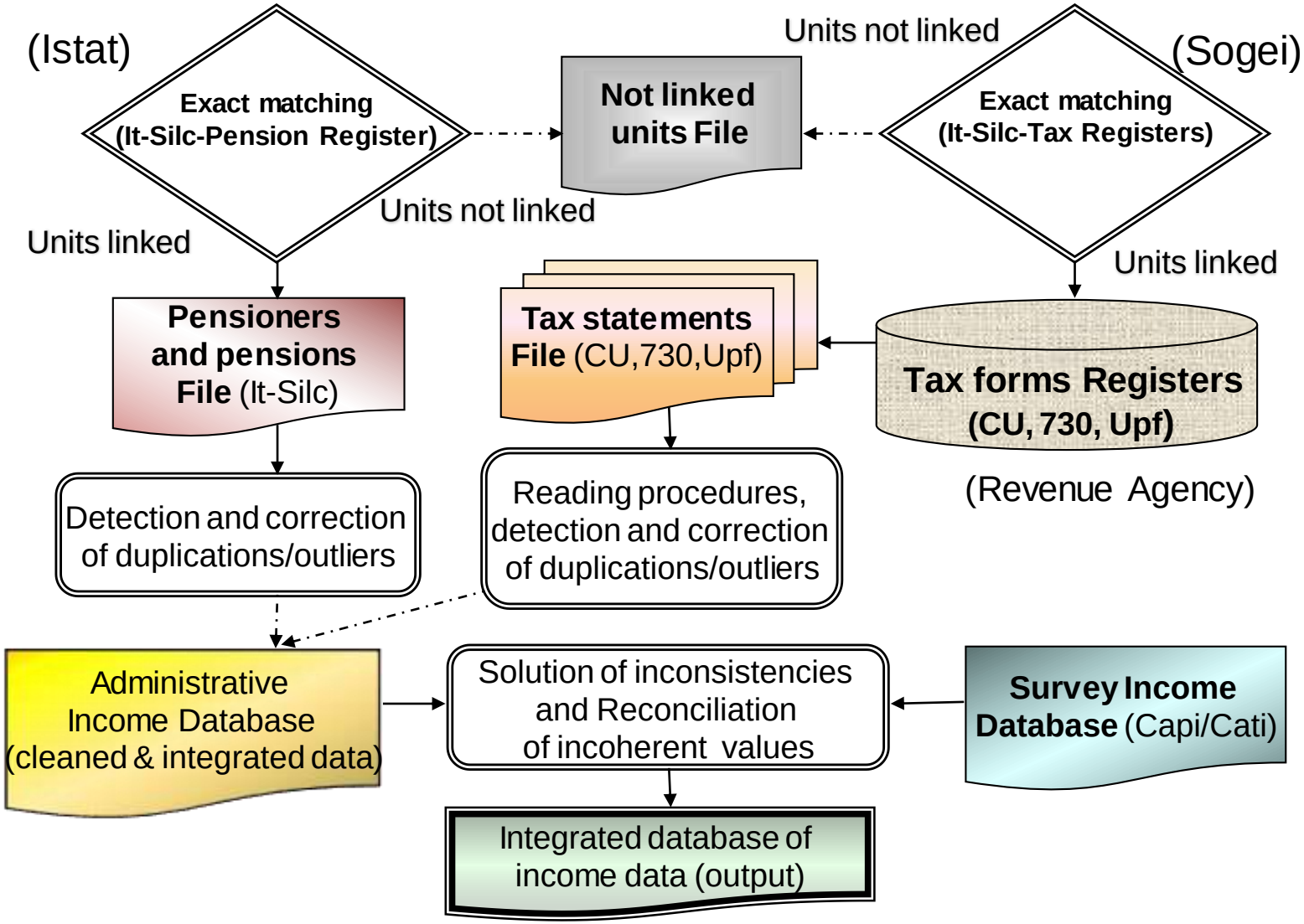
The Integration Process of Survey & Admin Source:

1. **Input data (survey):** **Personal tax numbers** and personal items (used to generate them) are retrieved from SIGIF (Population register)
2. **Input data (administrative sources):** **Personal tax numbers** are checked and corrected. Information coming from multiple records and relating to the same person is organized in order to avoid duplications or double counting
3. **Exact matching procedure and harmonization:** survey and administrative sources are matched using the **Personal tax number** as the key variable. The result is a matched file
4. **Detecting and solving inconsistencies on income in the matched file:** an inconsistency arises whenever survey and administrative sources assign a different type of income to the same person
5. **Reconciliation of incoherent income values:** even in presence of a consistent structure of incomes between administrative and survey data, they could display incoherent income levels

Data processing operations – Part 1

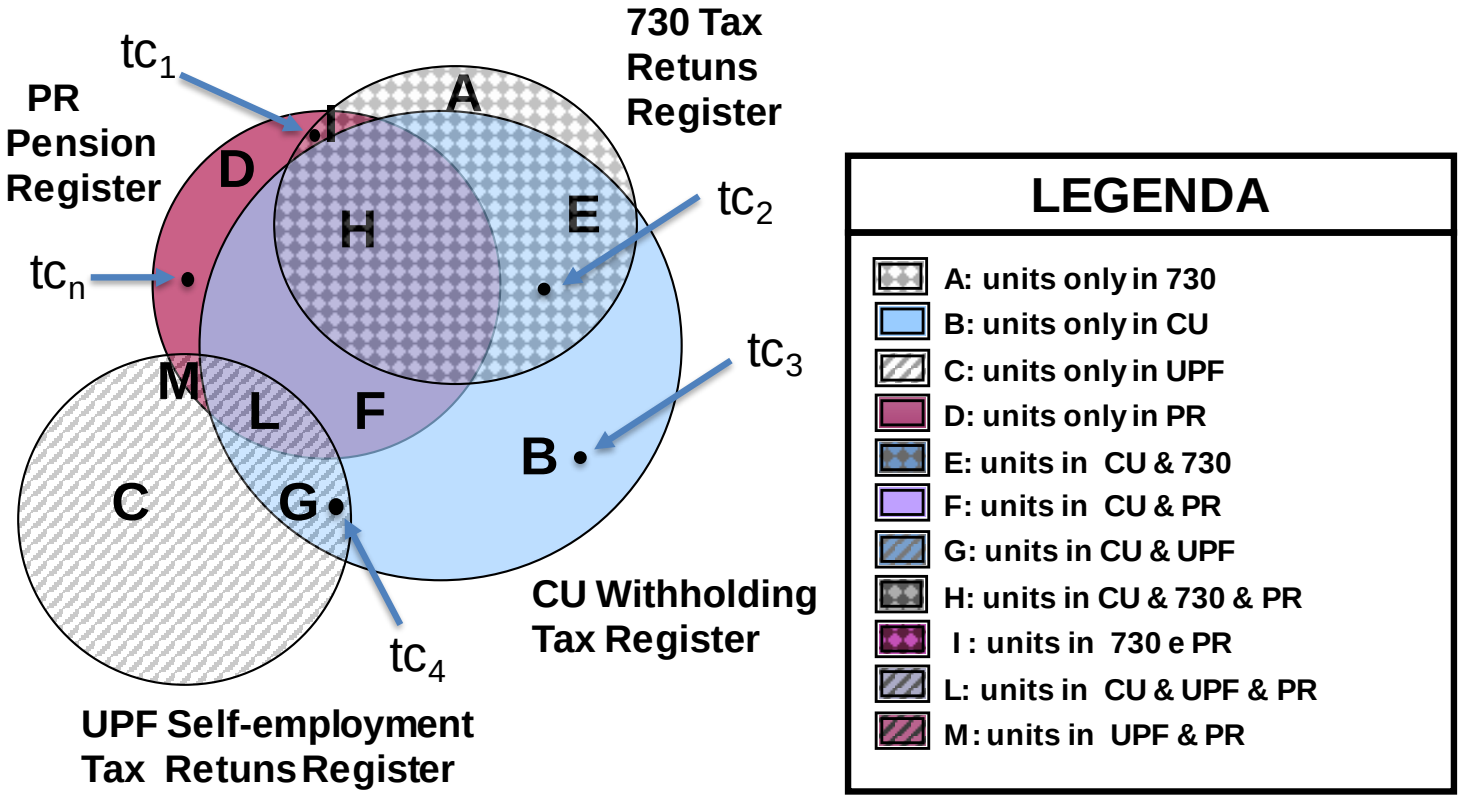


Data processing operations – Part 2



Graphical representation of Admin Income Database

- AID is a "integrated statistical database for selected objects (sample units)" that combines several administrative sources



$$\Omega' = A \cup B \cup C \cup D \cup E \cup F \cup G \cup H \cup I \cup L \cup M$$

Admin Income Database: structure

Personal identification Number (tax-codes)	Tax Registers: CU Tax Withholding	Tax Registers: 730 Not S.E. Tax returns	Tax Registers: UPF Self-Empl. Tax returns	Pension Register
subset: **I**				Income var. P
tc_1	Missing(XP_1)_CU	**Value(XP_1)_730**	Missing(XP_1)_UPF	**Value(YP_1)_PR**
subset: **E**				Income var. E
tc_2	**Value(XE_2)_CU**	**Value(XE_2)_730**	Missing(XE_2)_UPF	Missing(XE_2)_PR
subset: **B**				Income var. E
tc_3	**Value(XE_3)_CU**	Missing(XE_3)_730	Missing(XE_3)_UPF	Missing(XE_3)_PR
subset: **G**				Income var. E
tc_4	**Value(XE_4)_CU**	Missing(XE_4)_730	**Value(XE_4)_UPF**	Missing(XE_4)_PR
……				
subset: **D**				Income var. P
tc_n	Missing(XP_n)_CU	Missing(XP_n)_730	Missing(XP_n)_UPF	**Value(YP_n)_PR**

The classification/reclassification of the income components

The framework :

1) ***Primary classification*** **of the income components based on CU tax withholding register**

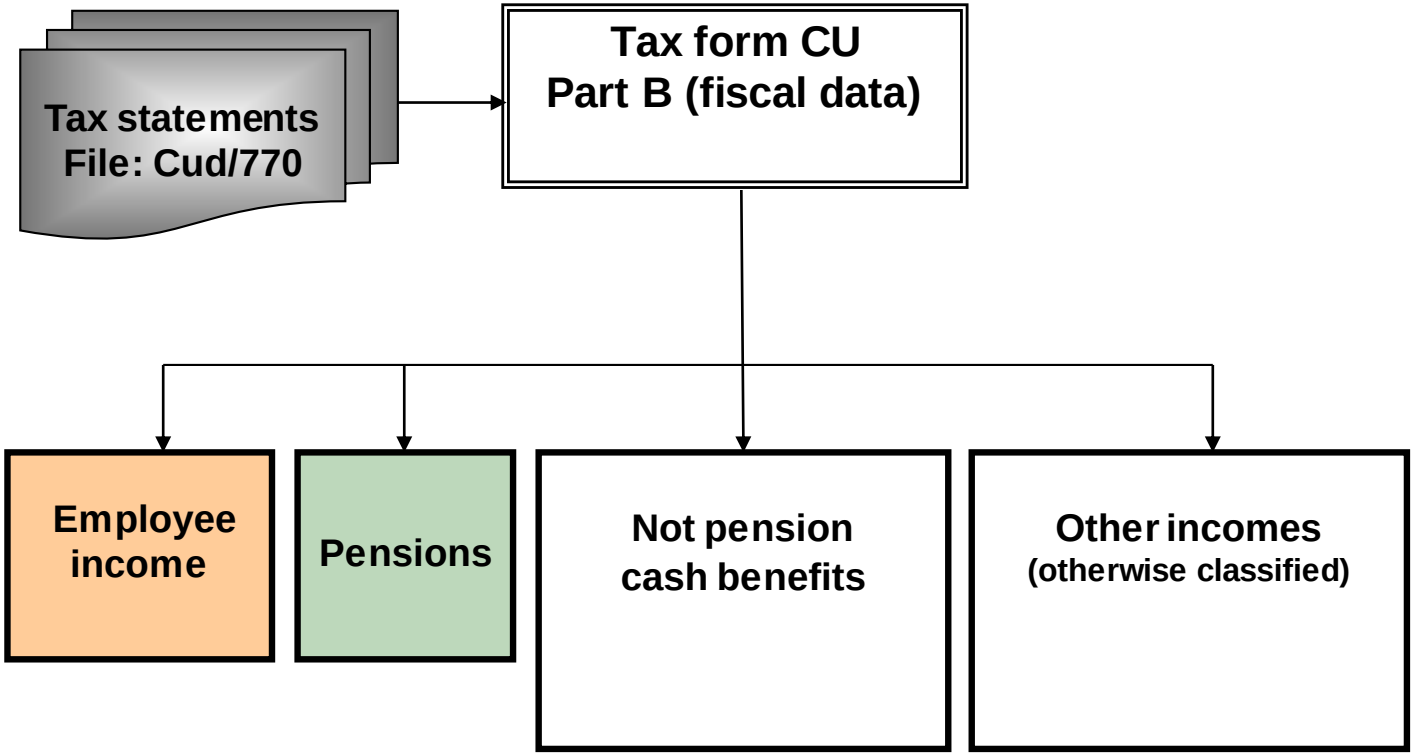
2) ***Secondary classification*** **if the income components based on auxiliary information: mod.730 e Upf tax returns**

3) ***Reclassification*** **of the income components based on Pension Register**

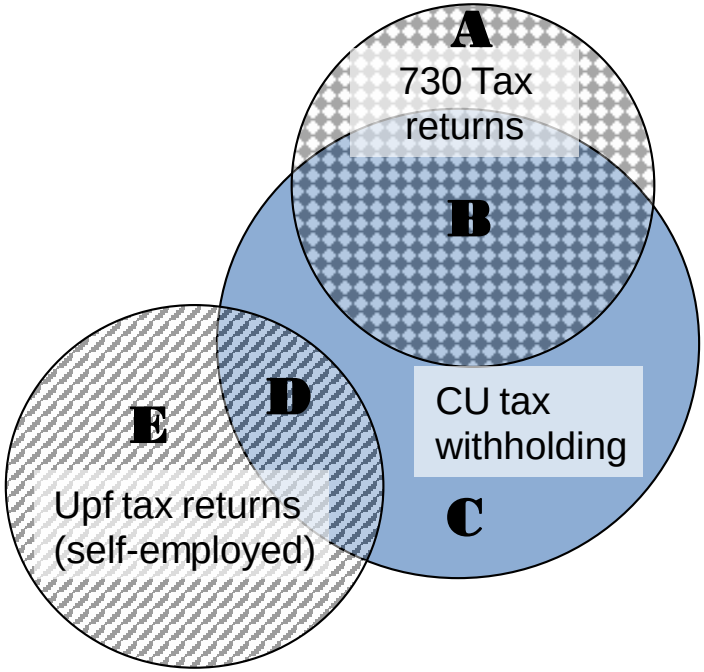
Primary classification of the income components

Cu tax withholding

Variables employed: flag on kind of taxable incomes, deductions, type of withholding agents, social contributions



Secondary classification of the income components based on auxiliary information: mod.730/Upf tax returns (sets **A** and **E**)

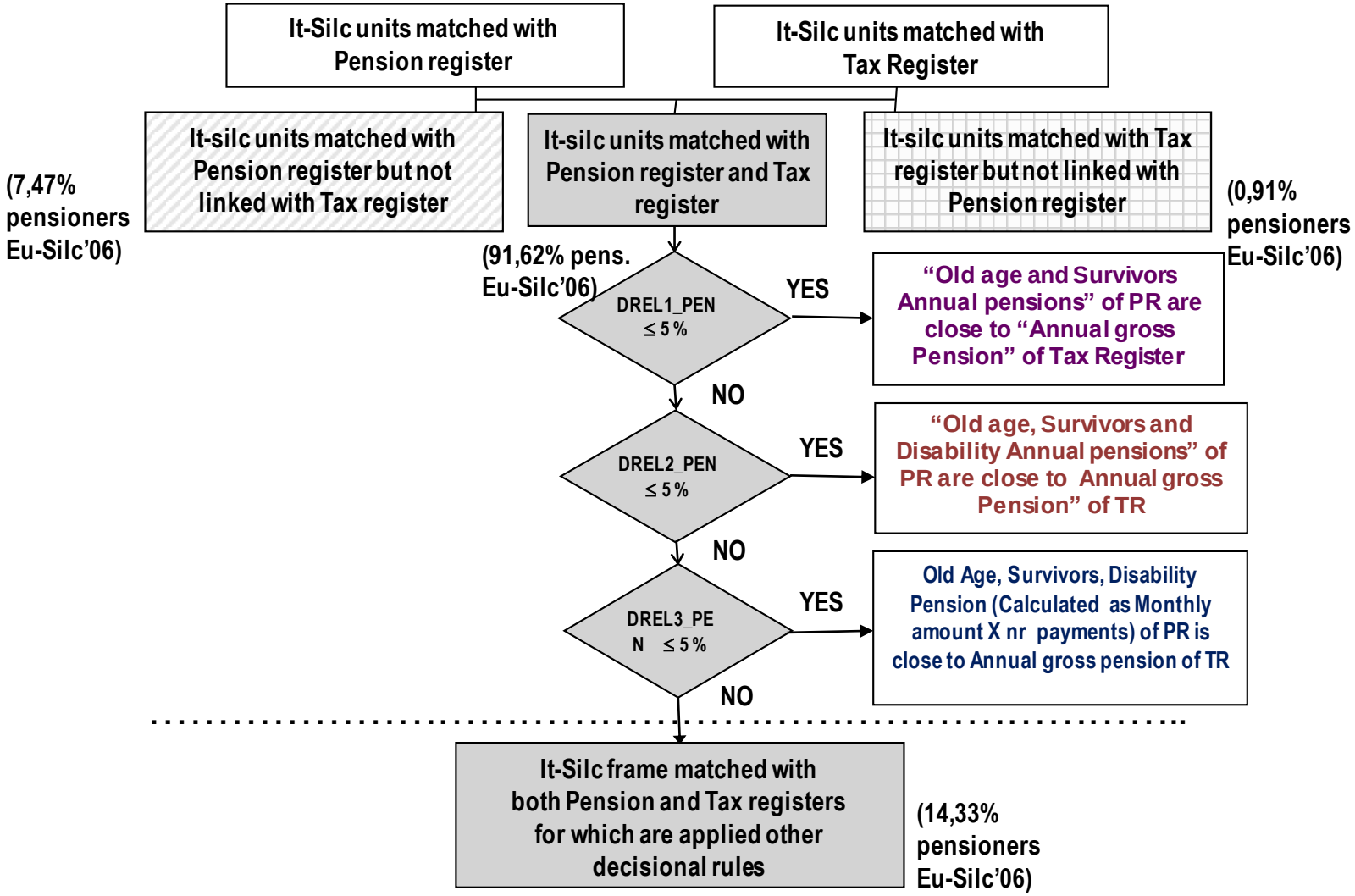


$$\Omega = \mathbf{A} \cup \mathbf{B} \cup \mathbf{C} \cup \mathbf{D} \cup \mathbf{E}$$

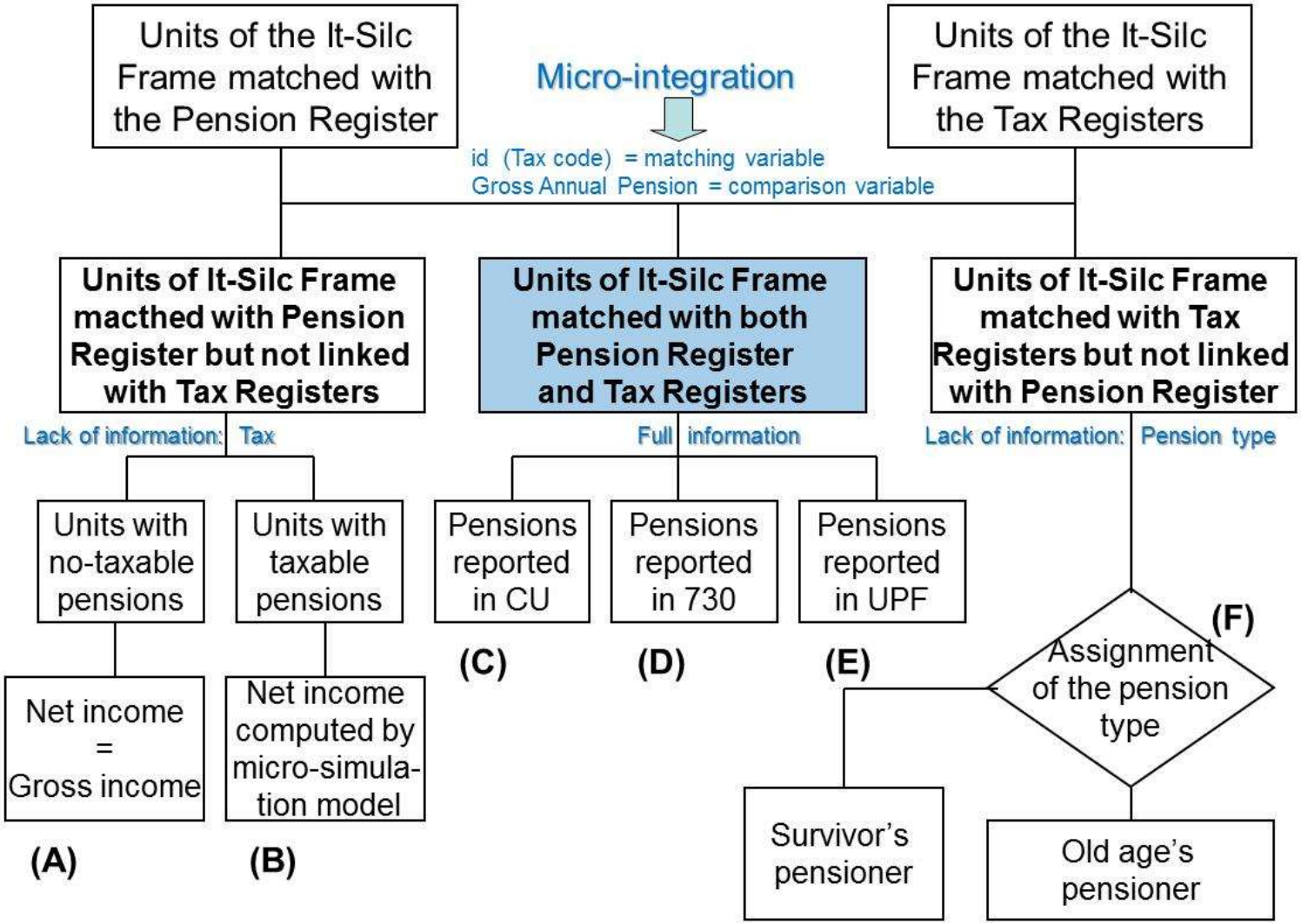
LEGENDA

- Only 730 tax returns
- Only CU tax withholding
- Only UPF tax returns
- CUD and 730 tax declarations
- CUD and UPF tax declarations

Reclassification & reconciliation of the income components based on Pension register and Tax registers



Micro-integration of Pension and Tax Registers



The micro-data integration process of different data-sources involves the satisfaction of the following requirements (P. van der Laan 2000):

Part 1

a. **harmonization of units:** **are the statistical units defined uniformly in all sources? (comparability in space and time)**

b. **harmonisation of reference periods:** **do all data refer to the same period or the same point in time?**

c. **completion of populations (coverage):** **do all sources cover the same target population?**

d. **harmonisation of variables/classifications:** **are corres-ponding variables defined (classified) in the same way? (comparability in space and time)**

The integration process of different data-sources involves the satisfaction of the following requirements (P. van der Laan 2000):

Part 2

e. **adjusting for measurement errors (accuracy): after harmonising definitions, do the corresponding variables have the same value?**

f. **adjusting for missing data (item non-response): do all the variables possess a value?**

g. **derivation of variables: are all variables derived using the combined information from different sources?**

h. **checking overall consistency: do the data meet the requirements imposed by identity relations?**

Inconsistencies analysis on incomes

- **A first type of inconsistency arises from the presence of a specific component of income in the survey (declared during the interview) that is not reported in the Tax registers**

- **A second type of inconsistency occurs when a type of income is recorded in Tax registers but not in the survey**

Solution of inconsistencies:

- Scope: assigning the "most likely" income pattern to each unit
- Strategy: it depends on the income type (generally the administrative source is assumed to be more reliable than survey data - except for self-employment income). Hierarchical approach: firstly employee income, secondly self-e. incomes, …
- Analysis: comparison of the respondent's professional status (or economic activity) between "survey" and "administrative" sources; identification of potential classification errors in income structures from the survey; inclusion of incomes from underground economy
- Actions: removal-replacement-integration of income components
- Advantages: avoiding misclassification of income components, reducing double counting (the same amount classified in different way) and removing interviewer falsification.

Reconciliation of self-employment income values is based on:

Maximum Rule: impose the maximum value between interviews and tax file:

$Y_{s\text{-}e}$=max(Net income reported by the interviewees or imputed*, After tax income) -

H_0: both data-sources underestimate the true value on self-employment income.

$\Rightarrow$ *the measurement error is "minimised" by using the maximum value between the two data-sources.*

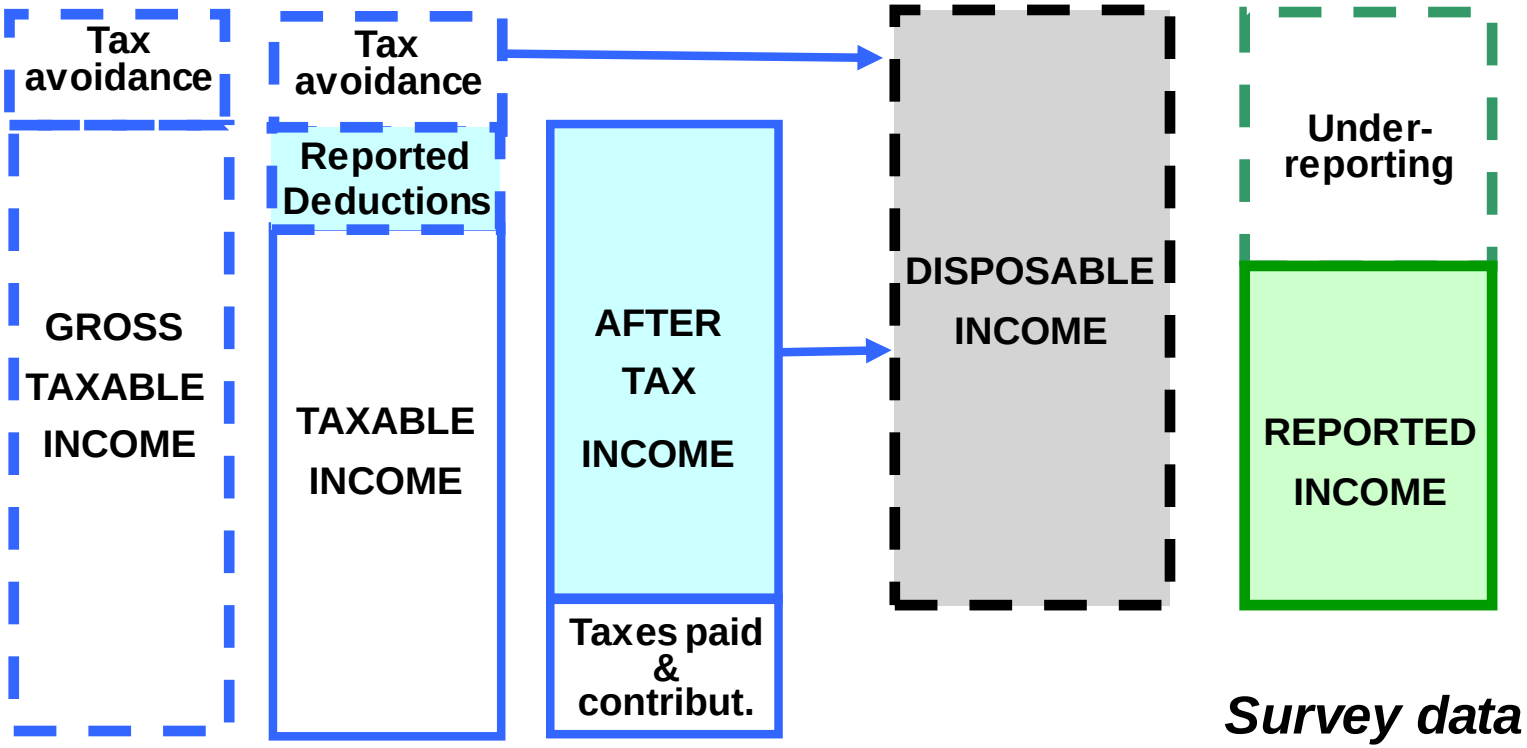
Note(*): multivariate sequential regression approach based on the information collected on individuals/households during the interview

Adjusting for measurement errors: 1st case

1st case: Under-reporting > Tax avoidance

=> "After tax income" > Reported "Net income"

=> "After tax income" is closer to true "Disposable income"

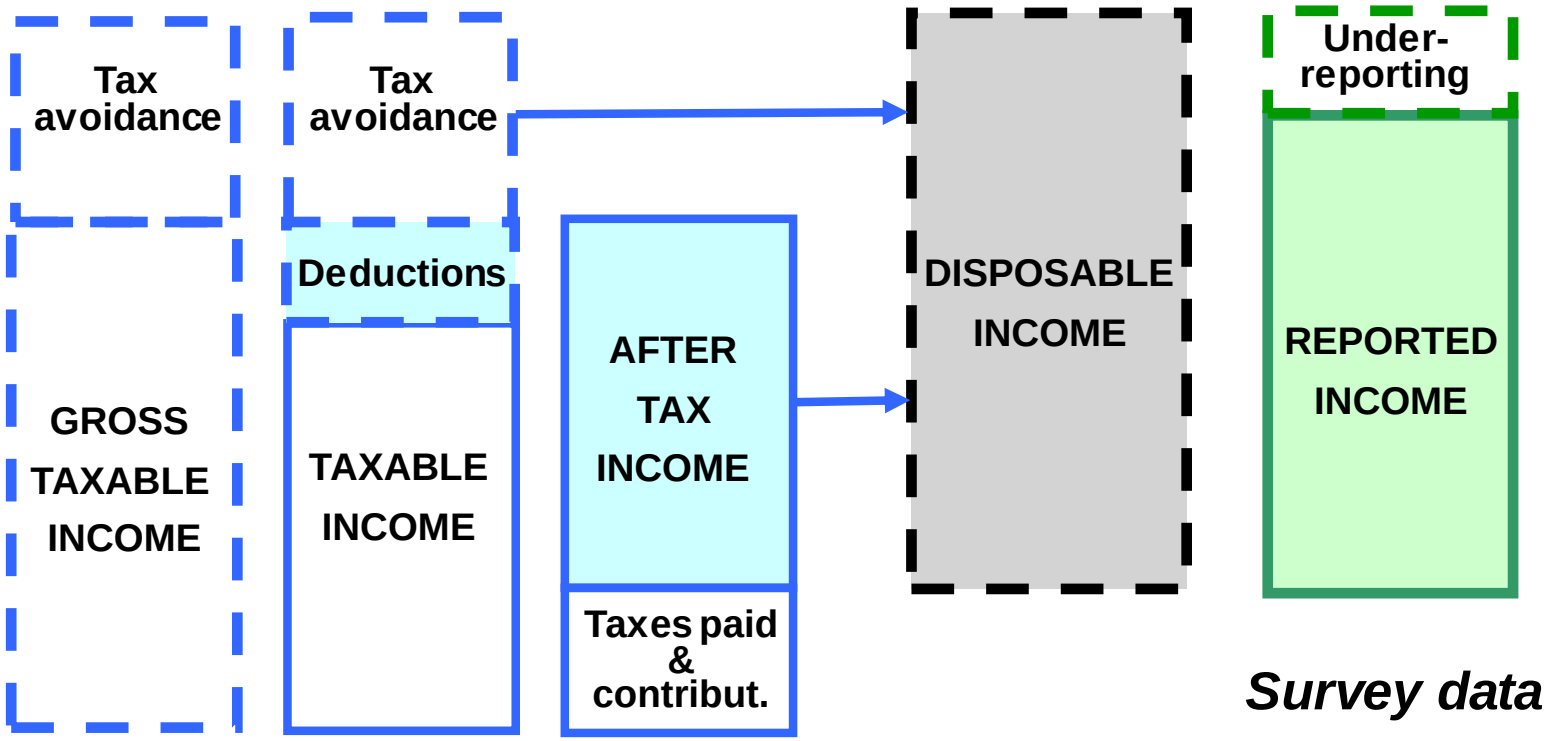


Adjusting for measurement errors: 2nd case

2nd case: Tax avoidance > Under-reporting

=> Reported "Net income" > "After tax income"

=> Reported "Net income is closer to true "Disposable income"



Some specific problems to MR approach:

The definition of *taxable* self-employment income in Italy is quite complex. There is not a set of simple, wide-ranging rules to convert the accounting profits: normal income of professional, deduction of profits retained and reinvested in the business, etc.

Interviewers have to refer to *"money drawn out concept" when they ask for self-employment income (no to taxable income):*

self-employment activity leads to a revenue if the individual or her/his family has got from this activity an amount of money that has been used for personal/household expenses, save or investment

Reconciliation of employee income is based in the following decision rules:

- The survey if reported only in the questionnaire but not in tax data;
- The tax data if the interviewee declares an employee income in a tax statement but does not report this income in the questionnaire (cold-deck imputation that selects donors from tax file – record linkage);

- Survey/tax source according to this decision rule :
- if tax value > survey value => tax data
- If (tax value +10%* tax value) > survey value > tax value => survey data
- If 2*(tax value) > survey value > (tax value)*110% => tax data
- If survey value > 2*tax value => closeness respect to the predicted value estimated by a multiple regression (only questionnaire data)

In this way it is possible include in the final record the undeclared income (pay hidden) and at the same time to avoid the inclusion of outliers (errors produced by interviewees that report annual employee income instead of monthly employee income)

Concluding remarks

Integration of Survey & Administrative data (ISAD)

❑ Advantages	❑ Drawbacks
▪accuracy ▪coherence ▪completeness ▪cost and response burden (C&RB) reduction	▪relevance ▪timeliness

Concluding remarks

Advantages:

- **Accuracy**: ISAD reduce or remove selecting non-response and measurement errors (memory/telescoping effects)
- **Coherence**: is improved through the use of common definition, classification and conceptual frameworks
- **Completeness**: through ISAD is possible to increase the coverage rate on the target population
- **C&RB reduction**: by eliminating items from the data collection when administrative information is available

Concluding remarks

Drawbacks:

- **relevance**: items conform to administrative (not statistical) concepts few concessions to statistical needs
- **timeliness**: generally slow, **constrains** for timely releasing of administrative data because of bureaucracy, **time-consuming** cleaning-procedure carried out by data producers

Micro-simulation of gross income variables

- **The construction of IT-SILC gross income variables**
  - The microsimulation model SM2/EU-SILC is developed and applied for the net-to-gross conversion of incomes
  - Survey and administrative data are jointly used in the micro-simulation process
  - Final microsimulation estimates are compared to register data at the micro-level, in order to assess the quality of the microsimulation.

Future Developments

- **Response burden reduction:** replacement of questionnaire items with administrative information

- **Timeliness**: a new release schedule will be applied (2020 edition?). Effort will be made to anticipate the transmission deadline of full dataset to Eurostat by 11 months (from November T+2 to December T+1), a revised file will be produced later. The administrative data acquisition program will be re-negotiated with data providers, new strategies will be designed (statistical models)

- **Coverage enhancements**: a massive use of social security's database in order to cover utmost information on non-pension cash benefits and an exploitation of new fiscal databases in order to estimate the income from capital assets

References

- Canberra Group Handbook on Household Income Statistics (2011)
- Consolini, P., Di Marco, M., Ricci, R. and Vitaletti, S. (2006), '*Administrative and Survey Microdata on Self- Employment: the Italian Experience with the EU-SILC project'*, IARIW 29th General Conference, Joensuu, Finland, 20-26 August.
- Consolini P., Donatiello G. (2013). "Improvements of data quality through the combined use of survey and administrative sources and micro simulation model". Eurostat. The use of registers in the context of EU–SILC: challenges and opportunities. Statistical Working Paper. Luxembourg. Publications Office of the European Union 2013.
- Newcombe, H.B. (1988), '*Handbook of Record Linkage: Methods for Health and Statistical Studies, Administration, and Business'*, Oxford University Press, Oxford, UK.
- van der Laan, P. (2000), '*Integrating administrative registers and household surveys'*, Netherlands Official Statistics vol.15, Summer.
- Wallgren A. & Wallgren B. (2007), *Register-based Statistics Administrative Data for Statistical Purpose*, John Wiley & Sons, Ltd

consolin@istat.it

Thank you for your attention!